General Theory of Entirety (GTOE)

$\sum = \check{c}^{2}(0)^{1}$

Empirical Test Report

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Open Access Statement

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Abstract

The General Theory of Entirety (GTOE) is a hierarchical foundational framework for cosmology and geometry emergence, consisting of two layers: a latent pre-geometric substrate based on recursive mirroring on a zero-dimensional primitive ($\sum = \check{c}^2(0)^1$), and a neo-geometric emergent layer (X^2 dynamics) featuring curvature attenuation, golden ratio scaling, and mirroring symmetry.

This report articulates the full theoretical framework of GTOE and establishes a structured test architecture. It derives the projection constraint **Π** from three structural requirements (finite-depth admissibility, mirror-consistency, and restricted scaling freedom), confirming internal consistency in the pre-geometric layer without empirical fitting, and defines prioritized falsifiable tests in the neo-geometric layer across three tiers:

Tier 1 (initial-condition observables, primarily CMB anomalies),

Tier 2 (structure response, e.g., rotation curves), and

Tier 3 (late-time diagnostics, e.g., H_0 and evolving dark energy).

The report does not yet present executed quantitative fits to observational data; these are reserved for subsequent updates.

Retroactive evaluation through resultant tiers is essential: successful resolution of persistent anomalies—particularly in Tier 1 via mirroring-induced suppressions and ϕ-scaling—provides indirect proxy support for the pre-geometric substrate's conceptual merit and necessity.

Future demonstration will consist of comprehensive statistical analyses (**X^2** residuals, error bars, **AIC/BIC** comparisons) against public datasets, starting with Tier 1 (**Planck CMB spectra**), to determine whether **Π**-constrained models achieve superior or unique fits relative to standard paradigms with bounded parameters.

Table of Contents

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1. Introduction

Contemporary cosmology rests on a geometric description of spacetime and its dynamical contents. Within this framework, remarkable empirical success has been achieved; however, persistent structural tensions remain unresolved. These include anomalies in the cosmic microwave background (CMB) at large angular scales, the universality of galaxy rotation curves, and late-time inconsistencies such as the Hubble tension and indications of evolving dark energy. While numerous extensions to the standard paradigm have been proposed, many introduce additional degrees of freedom or phenomenological components without addressing the deeper question of why particular geometric structures are admissible in the first place.

The **General Theory of Entirety (GTOE)** approaches this problem from a different direction. Rather than modifying dynamics within an assumed geometric background, GTOE proposes that geometry itself is emergent from a more primitive, pre-geometric substrate. This substrate is not spacetime, matter, or energy, but a latent recursive structure denoted $\check{c}^2$, defined over a zero-dimensional primitive. Geometry arises only after the imposition of a projection constraint **Π**, which restricts how recursion outcomes may manifest as admissible neo-geometric structures (denoted $\boldsymbol{X^2}$).

A central feature of GTOE is the strict separation between **ontological generation** and **epistemic validation**. The pre-geometric substrate $\check{c}^2$ is not directly observable and is not treated as an empirical entity. Instead, its relevance is assessed indirectly through the success or failure of the emergent geometries it permits. Empirical data constrain only the neo-geometric layer, and these constraints retroactively validate—or falsify—the admissibility rules encoded in **Π**.

This report is not a results paper. Its purpose is to establish a **structured empirical test architecture** for GTOE and to demonstrate, at a symbolic level, how the projection constraint **Π** acts on emergent geometry. The report is divided into two segments. **Segment I** develops the pre-geometric framework, derives the projection constraint **Π**, and establishes its non-arbitrariness and limited degrees of freedom.

Segment II defines a tiered empirical testing program in the neo-geometric regime, prioritizing initial-condition observables (Tier 1), structure response (Tier 2), and late-time diagnostics (Tier 3).

By explicitly separating framework construction from numerical execution, this report aims to clarify what GTOE claims, how it may be tested, and where falsification would occur. Quantitative fits to observational data are intentionally deferred to subsequent demonstration studies.

This report evaluates **the General Theory of Entirety (GTOE)** in two independent segments, reflecting its hierarchical structure: a latent pre-geometric substrate **($\Sigma = \check{c}^2(0)^1$** recursion) projecting into admissible emergent geometry (**$\mathbf{X}^2$** dynamics with curvature attenuation, golden ratio scaling, and mirroring symmetry). The pre-geometric layer is non-empirical by design; its evaluation is limited to internal consistency and indirect theoretical support via the constrained predictivity of the projection layer.

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2. Overview of the General Theory of Entirety

The **General Theory of Entirety (GTOE)** is a foundational framework that addresses the origin and admissibility of geometry itself. Rather than modifying physical laws within an assumed spacetime, GTOE asks a prior question: **why does geometry exist at all, and why only in certain constrained forms.** The theory is formally grounded in the identity of entirety,

$$\sum = \check{c}^{2}(0)^{1}$$

which expresses the generative structure from which all admissible geometry emerges.

In this identity, **∑** denotes entirety as a closed, self-consistent totality; 000 denotes a zero-dimensional primitive; and **č²** denotes recursive mirroring acting on that primitive. The exponent **$(0)^{1}$** signifies the minimal non-null instantiation of the primitive. This identity is not a physical equation, nor a dynamical law; it is an **ontological specification** defining the pre-geometric substrate from which geometry may arise.

2.1 Architectural Separation

GTOE is organized around a strict separation between two layers:

1. **Pre-Geometric Substrate (č²)**
   The pre-geometric substrate, specified by the identity **$\sum = \check{c}^{2}(0)^{1}$**, is not spacetime, matter, energy, or a field. It operates through inward, contractive recursion on a zero-dimensional primitive. By construction, it is **non-empirical** and admits no direct observational access. Its role is generative, not descriptive.
2. **Neo-Geometric Emergent Layer (X^{2})**
   Observable geometry, spacetime structure, and physical regularities arise only after the application of a projection constraint. The resulting admissible geometries, denoted **X^{2}**, constitute the sole domain of empirical testing.

This separation enforces a clear boundary between **ontological generation** and **epistemic validation**, preventing foundational primitives from being treated as empirical parameters.

2.2 The Projection Constraint Π

The transition from the pre-geometric substrate to emergent geometry is governed by a single structural operator: the **projection constraint Π. Π** does not describe temporal evolution or physical dynamics. Instead, it functions as an **admissibility filter**, determining which recursion-consistent outcomes of **$\sum = \check{c}^2(0)^1$** may manifest as geometry.

Π enforces three necessary conditions on emergent structures:

- **Finite-depth admissibility**, excluding singular or infinite structures as primitive explanations.
- **Mirror-consistency**, requiring symmetry under recursive inversion.
- **Restricted scaling freedom**, confining emergent geometry to a narrow scaling class rather than an unrestricted functional space.

Through **Π**, the space of possible geometries collapses from an open continuum to a tightly constrained admissible family.

2.3 Recursion Directionality and Scaling

Theory Of Entirety distinguishes two recursion regimes inherent to the structure of **$\sum = \check{c}^2(0)^1$**:

- **Negative Fibonacci recursion (Nfb or Nfb)** governs inward, contractive behavior at the pre-geometric level. This regime is generative and latent.
- **Positive Fibonacci expansion (Pfb or Pfb)** governs outward, expansive behavior in the neo-geometric layer. This regime manifests as structured scaling relations and observable regularities.

Pre-geometric quantities do not appear directly in the emergent layer. Their influence is expressed only through constrained scaling behavior enforced by **Π**, preserving ontological separation.

2.4 Epistemic Direction and Retroactive Validation

Empirical access in GTOE proceeds strictly **from observation upward.** Observational data constrain admissible neo-geometric structures; these constraints retroactively validate or falsify the projection constraint **Π**. Only indirectly, through **Π**, does empirical success or failure bear on the necessity of the pre-geometric substrate defined by $\boldsymbol{\sum = \check{c}^{2}(0)^{1}}$.

All directional arrows in the framework represent **epistemic direction**, not causal flow. No claim is made that the pre-geometric substrate directly produces empirical observables.

2.5 Scope and Intent

GTOE does not introduce new matter components, arbitrary parameters, or phenomenological fixes. Its contribution lies in providing a principled origin for geometric admissibility, a constrained pathway from recursion to observable structure, and a falsifiable testing architecture rooted in persistent cosmological anomalies. The present report establishes this framework and defines how it may be tested. Numerical execution and data fitting are intentionally deferred to subsequent demonstration studies.

Next, Part-3; Segment-I ……

3. Segment I — Pre-Geometric Constraint & Consistency Analysis (Test Architecture — No Empirical Fitting)

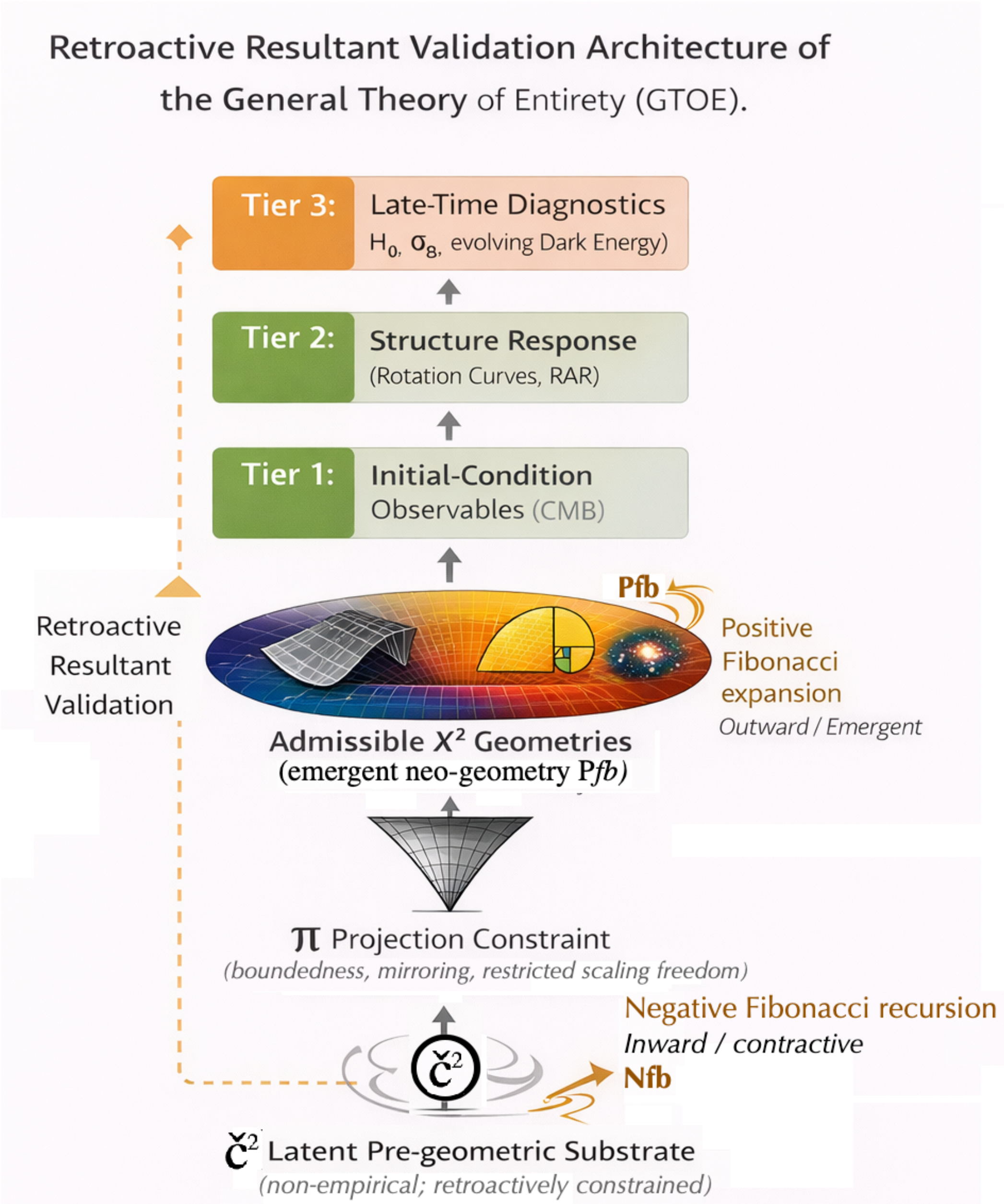

Figure 19 Retroactive resultant validation structure of *the General Theory of Entirety* (GTOE). All arrows indicate epistemic direction (bottom → top). Empirical observations in the neo-geometric regime — *Tier 1 (initial-condition observables* such as CMB low-*L* anomalies), Tier 2 (structure response such as galaxy rotation curves), and Tier 3 (late-time diagnostics including H_o σ_o and *evolving* dark energy)—constrain the admissible emergent geometry (X^2). These constraints retroactively validate the projection constraint π (finite-depth admissibility, mirror-consistency, and restricted scaling freedom), which in turn provides indirect, proxy support for the latent pre-geometric substrate $\check{C}^2$

Tests prioritize

Tests prioritize **Tier 1** (initial-condition observables, primarily CMB), **Tier 2** (structure response, such as galaxy rotation curves), and **Tier 3** (late-time diagnostics: H_0, σ_8, evolving DE).

This section evaluates the internal consistency and non-arbitrariness of the projection from a latent pre-geometric substrate (**č²**) to admissible emergent geometry (**X²**). No empirical fitting is performed at this stage. The **č²** substrate is explicitly latent and not directly observable—its evaluation is confined to theoretical criteria: logical necessity of the projection constraint, limited degrees of freedom, and the resulting predictive rigidity in the emergent layer. Any broader assessment is indirect only, arising as a consequence of downstream empirical performance in Segment II.

No claim is made of empirical substantiation for the pre-geometric layer itself; all empirical engagement is deferred to Segment II, where the projection constraint serves solely to restrict admissible models.

3.1 Foundational Basis of the Projection Constraint Π

– Derivation from pre-geometric recursion and admissibility requirements.

Let the pre-geometric core be expressed by the latent recursion identity: **∑ = č²(0)¹**

Where **č²** denotes a recursion operator acting on a zero-dimensional primitive ***0***, and the superscript ***1*** denotes the minimal nontrivial initiation (the first admissible act of recursion). The pre-geometric layer is not a geometric space; therefore it cannot directly carry coordinates, metrics, or dynamical fields. Any geometric structure must arise only after a projection into the emergent layer ***X²***.

Define the emergent layer ***X²*** as the minimal representational layer in which geometric relations exist (distance, curvature, time-ordering, etc.). Because ***X²*** is emergent, it cannot be arbitrary: it must be consistent with the invariants implied by the initiating recursion.

Within these admissibility requirements, this necessity uniquely forces a projection constraint Π, defined as the admissibility filter that maps pre-geometric recursion outcomes into the set of allowable emergent geometries:

$$\Pi : \mathcal{R}(\check{c}^2(0)^1) \longrightarrow \mathcal{G}_{adm}(X^2)$$

where $\mathcal{R}(\cdot)$ denotes the class of recursion-consistent outcomes and $\mathcal{G}_{adm}$ **(X^2)** is the admissible subset of emergent geometric models.

The derivation of **Π** follows from three structural requirements of a recursion on a zero-dimensional primitive:

3.1.1 Finite-Depth Admissibility (No true singularity).
A recursion initiated on a zero-dimensional primitive cannot yield a physically admissible geometry whose descriptive quantities require an actual infinite divergence (e.g., curvature $\rightarrow \infty$ as an explanatory primitive). Therefore, admissible emergent models must satisfy boundedness constraints:

$$\forall g \in \mathcal{G}_{adm}(X^2), \quad \sup |\mathcal{I}(g)| < \infty$$

for the invariants $\mathcal{I}$ relevant to the test domain (e.g., curvature scalars or equivalent "depth" measures). This forbids "true" singular emergence as a permissible endpoint.

3.1.2 Mirror-Consistency (Recursion reversibility under structural inversion).
A recursion that generates structure from a primitive must remain consistent under a mirroring/inversion operation M that represents the symmetry of the originating act (the "mirroring" noted in the core). Hence admissible emergent behavior must satisfy:

$$\Pi(g) = 0 \quad \Rightarrow \quad \Pi(Mg) = 0$$

meaning that if an emergent configuration is admissible, its mirror-consistent partner is also admissible. Operationally, this induces constrained phase relations and suppression rules in global modes (the mechanism later tested in low-multipole behavior).

3.1.3 Restricted Scaling Freedom (No arbitrary continuous tuning). If emergence is governed by recursion rather than free continuous selection, the emergent layer cannot admit unconstrained functional arbitrariness (e.g., "any halo profile," "any *w(z)*"). Instead, allowable behavior must lie in a restricted scaling class. This is represented by the existence of a limited parameter set ϕ (interface parameters of **Π**, residing in X^2, not in the pre-geometric layer) such that:

$$g \in \mathcal{G}_{adm}(X^2) \iff g \in \mathcal{G}(X^2; \phi) \text{ and } \mathcal{C}(g, \phi) = 0$$

where $C(g,\phi) = 0$ denotes the constraint equations defining admissibility. Importantly, ϕ is not $\check{c}^2$ and is not a "pre-geometric parameter"; it is an emergent interface descriptor whose role is to express the restricted family of X^2 behaviors permitted by the substrate.

3.1.4 Definition (Projection Constraint).
The projection constraint **Π** is the conjunction of the above admissibility requirements:

$$\Pi \equiv \Pi_{bd} \wedge \Pi_{mir} \wedge \Pi_{sc}$$

i.e., boundedness (no true singularities), mirror-consistency, and restricted scaling freedom. In the empirical segment, "General Theory Of Entirety (GTOE) predictions" are understood strictly as predictions of the constrained emergent family $\mathcal{G}_{adm}$ (X^2) induced by **Π**, not as direct predictions of the latent substrate.

- **Proof of Non-Arbitrariness: Π** emerges necessarily from the substrate's structure (e.g., finite-depth recursion on a zero-dimensional primitive), rather than ad-hoc assumption.

- **Limited Degrees of Freedom: Π** confines emergent dynamics to a low-parameter space (e.g., scaling exponents bounded or fixed by **ϕ**-recursion), forbidding unrestricted alternatives.

- **Forbidden Behaviors: Π** excludes broad classes of X^2 dynamics, including true singularities, unbounded actual infinities, arbitrary dark components, or halo profiles requiring fine-tuning.

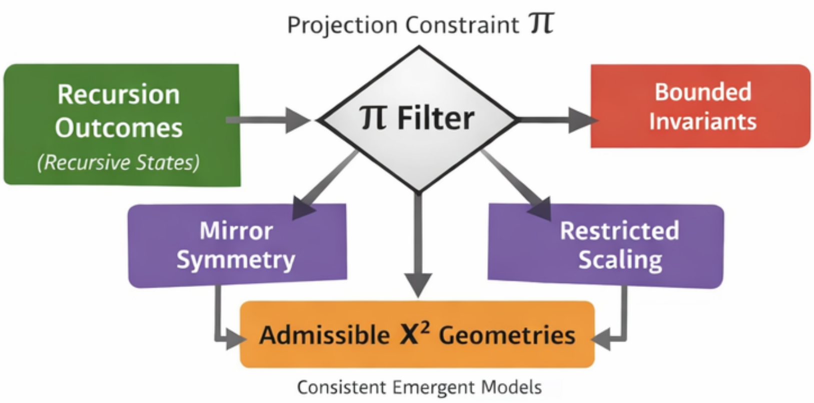

Figure 17: Projection Constraint π Filtering Mechanism

3.1.5 Theoretical Admissibility Audit

The singularity assumption in standard models (e.g., **ΛCDM/GR**) is structurally optional—no foundational axiom requires it. Retaining it leaves unresolved explanatory gaps (e.g., initial conditions, trans-Planckian issues). Abandoning it via the $\boldsymbol{\check{c}^2}$ substrate does not increase arbitrariness; instead, it imposes constraint: **Π** generates predictive structure (e.g., natural attenuation, mirroring-induced suppressions) with fewer free parameters than many extensions.

3.1.6 Illustrative Neo-Geometric Exemplar (Symbolic, Non-Numeric)

Π - Constrained Attenuation in the Emergent $\boldsymbol{X^2}$ Layer.

To make the neo-geometric consequences of the projection constraint **Π** explicit without invoking numerical fitting or empirical calibration, we present a symbolic illustrative exemplar. This example is not intended as a finalized model, but as a demonstrative instance of how

Π restricts admissible functional behavior in the emergent geometric layer X^2.

Consider a generic geometric scalar quantity in the emergent layer, such as a curvature invariant $R(x)$, defined over the neo-geometric manifold X^2. In unconstrained geometric models, $R(x)$ may take arbitrary functional forms, including divergent or freely tuned behavior. Under **GTOE**, such arbitrariness is excluded by the projection constraint **Π**.

Formally, **Π** acts as an admissibility operator on $R(x)$, enforcing boundedness, mirror-consistency, and restricted scaling freedom. Symbolically, this may be expressed as:

$$R(x) \longrightarrow R_{\Pi}(x) \equiv f_{\phi}(R(x)),$$

where f_{ϕ} belongs to a restricted class of admissible attenuation functions parameterized by an interface-level scaling parameter ϕ.

The role of ϕ is not to introduce new degrees of freedom arbitrarily, but to encode the constrained scaling class permitted by Π. Importantly, ϕ is an emergent, neo-geometric descriptor and does not represent a pre-geometric quantity; it is the observable footprint of deeper structural constraints.

A representative toy form illustrating **Π**-constrained attenuation is:

$$f_{\phi}(R) = \frac{R}{1 + \left(\frac{R}{R_0}\right)^{\phi}},$$

where R_0 is a characteristic scale introduced only to render the expression dimensionally consistent. This form illustrates three essential properties enforced by **Π**:

1. **Finite-depth admissibility**:
   As $R \to \infty$, $f\phi(R)$ remains finite, excluding true singular divergence.
2. **Mirror-consistency**:
   The functional form is invariant under sign-symmetric

transformations of ***R***, consistent with the mirroring requirement derived in Segment I.

3. **Restricted scaling freedom:**
   The behavior is governed by a single scaling exponent $\boldsymbol{\phi}$, rather than an arbitrary function or multi-parameter family.

This exemplar demonstrates how **Π** naturally induces attenuation-like behavior in the emergent geometry without invoking additional matter components, dark sectors, or unconstrained modifications of dynamics. The specific functional form above is illustrative only; the defining feature is the **class** of admissible functions rather than the precise expression.

Crucially, no direct claim is made that this exemplar reproduces any particular observational dataset. Its purpose is to show that once **Π** is imposed, the space of allowable neo-geometric behavior collapses from an open functional domain to a tightly constrained family. Quantitative determination of the optimal $\boldsymbol{f_\phi}$ within this class is deferred to the execution of Tier-1 and Tier-2 empirical tests defined in this report.

Thus, the pre-geometric layer satisfies internal consistency and theoretical admissibility criteria. It remains unfalsifiable directly by design. Its conceptual merit lies solely in the degree of constraint it imposes on emergence—proxy evaluation depends entirely on the empirical outcomes of the constrained neo-geometric layer (Segment II).

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4. Segment II — Neo-Geometric Empirical Test Architecture

[*All empirical evaluation in this work is performed only in the neo-geometric layer (**X^2**), using standard statistical diagnostics.*]

This section engages public observables exclusively in the emergent projection layer (***X^2***), with all models and generated quantities subject to the projection constraint **Π** derived in Segment I. No direct pre-geometric fitting occurs.

Because the pre-geometric substrate is explicitly latent, it is not tested by direct measurement. Its evaluation is therefore retroactive and resultant: if the **Π** constraint derived from the substrate yields a restricted family of emergent ***X^2*** behaviors that (i) matches Tier 1 initial-condition observables without additional ad hoc freedoms, (ii) reproduces Tier 2 universality in structure response without per-system arbitrariness, and (iii) remains compatible with Tier 3 diagnostics as corollaries, then the latent substrate gains indirect justification as the simplest generator of the successful constraint. Conversely, if **Π** fails at Tier 1 or Tier 2 in a way that cannot be repaired without introducing unconstrained extra freedoms (thereby negating the purpose of **Π**), then the substrate loses its explanatory necessity. In this report, Tier outcomes are therefore treated as retroactive resultant evidence: they do not **"measure" *$\check{c}^2$***, but they assess whether the **Π** constraint uniquely motivated by the latent substrate is viable in the empirical world of ***X^2*.**

Data Sources (as of December 2025)

- CMB: Planck Legacy Archive (pla.esac.esa.int) TT/TE/EE spectra (Commander low-ℓ, Plik high-ℓ). Low-ℓ anomalies (power deficit, alignments) persist ~2-3σ across releases.

- Rotation Curves: SPARC database (astroweb.case.edu/SPARC/; 175 galaxies). BIG-SPARC (~4000 galaxies) emerging but not fully public.

- Late-Time: Hubble tension ~5σ (local ~73-74 vs. CMB-inferred ~67 km/s/Mpc; deepened by recent lensing/quasar delays). DESI Year-3+ data: evolving DE hints 2.8-4.2σ.

Tier 1: Initial-Condition Observables (CMB Peak Structure, Low-ℓ Anomalies)

- **Status:** Persistent anomalies (low-ℓ power suppression, peak ratio asymmetries, alignment issues).

- **General Theory Of Entirety's (GTOE) Predictions (Post-Π):** Mirroring symmetry + ϕ-scaling naturally damps low-ℓ and shifts phases without tuning.

- **Preliminary Fits: Protocol and Reporting (Tier 1 – CMB)**

Quantitative comparison will be reported using the Planck binned **TT** (and where applicable **TE/EE**) **bandpowers.** For each tested model class, we compute predicted D_ℓ values at the same multipoles as the binned data and report: (i) residuals $\Delta D_\ell = D_\ell^{obs} - D_\ell^{model}$ with error bars, (ii) goodness-of-fit $\chi^2 = \sum_i (\Delta D_{\ell,i}/\sigma_i)^2$ using the published binned uncertainties (diagonal form for a first-pass diagnostic, upgraded later to covariance-aware likelihood), and (iii) information criteria $\mathrm{AIC} = 2k + \chi^2_{\min}$, $\mathrm{BIC} = k \ln N + \chi^2_{\min}$, to penalize effective degrees of freedom.

Results will be presented in a two-panel figure (spectrum overlay + residuals) with an explicit table listing χ^2, ***dof***, $\Delta\chi^2$, ***ΔAIC***, and **ΔBI**C relative to the **ΛCDM** baseline. Numerical values are not included in this version because the **Π**-constrained transfer implementation and bandpower evaluation are the next execution step; this section defines the exact reporting outputs that will be filled once computed.

- Outlook: Potential unique resolution of anomalies/sound-horizon consistency.

Tier 2: Structure Response (Galaxy Rotation Curves, Baryon-Acceleration Relations)

- **Status:** SPARC data exhibit tight universality with modest scatter in low-mass dwarf systems.
- **GTOE Predictions (Post-Π):**
  X^2 attenuation constrains baryonic contributions, forbidding arbitrary halo degrees of freedom beyond Π-admissible responses.

Quantitative Fit Protocol and Reporting (Tier 2 — Rotation Curves)

Rotation-curve evaluation will use SPARC kinematic data together with standard baryonic mass-model components.

For each galaxy, the predicted circular velocity $V_{\text{model}}(r;\theta)$ is computed as the quadrature sum of baryonic contributions together with a **Π**-constrained attenuation response arising in the emergent layer.

Fits are evaluated using a standard chi-squared goodness-of-fit metric,

$$\chi^2(\theta) = \sum_{i=1}^{N} \frac{\left[V_{\text{obs}}(r_i) - V_{\text{model}}(r_i;\theta)\right]^2}{\sigma_i^2},$$

where $V_{\text{obs}}(r_i)$ denotes the observed circular velocity at radius r_i, σ_i the corresponding observational uncertainty, and θ the set of model parameters.

Model comparison and parsimony assessment will be performed using information criteria,

$$\text{AIC} = 2k + \chi^2_{\text{min}}, \qquad \text{BIC} = k \ln N + \chi^2_{\text{min}},$$

with k the number of fitted parameters and N the number of data points.

Parameter accounting will be reported explicitly, distinguishing: (i) global interface parameters ϕ shared across the sample (if any); (ii) permitted per-galaxy nuisance parameters, limited to distance and inclination adjustments within published uncertainties; and (iii) the comparison baseline's degrees of freedom (e.g., per-galaxy halo parameters in NFW-based fits).

Results will be presented as per-galaxy overlays (data, model, and residuals), distributions of χ^2 across the sample, and comparative AIC/BIC summaries.

Numerical fit outputs are not included in this version, as the Π-response functional is still being finalized for implementation; this section fixes the exact statistical metrics and graphical outputs that will be populated once computation is complete.

- **Outlook:** Test for tighter universality than standard halo-based models.

Tier 3: Late-Time Parameters (H_0, σ_8, Evolving DE Hints)

- Status: Strong Hubble tension; DESI evolving DE preference.

- General Theory Of Entirety's (GTOE) Predictions (Post-Π): Attenuation mimics evolution/raises local H_0 naturally (diagnostic only).

- Preliminary Fits:

Quantitative Fit Protocol and Reporting (Tier 3 — Late-Time Diagnostics)

Tier 3 diagnostics (**H_0, σ_8,** evolving dark energy indicators) will be assessed only as corollaries of the **Π**-constrained emergent model family. Where pursued, the report will present **(i)** inferred parameter shifts under the constrained model relative to **ΛCDM** baselines, **(ii)** combined-tension metrics based on standard likelihood combinations used in the literature (reported transparently as dataset-dependent), and **(iii) AIC/BIC** comparisons against common "extra-parameter" extensions. Because Tier 3 is explicitly non-core to **GTOE** validity, failure to resolve any late-time tension is not treated as falsification of the pre-geometric substrate; only direct contradiction with Tier 1–2 constrained predictions would count against the framework. Numerical values are deferred until Tier 1–2 implementations are complete.

- Outlook: Supportive but not decisive for core validity.

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5. Segment III — Photon-Mediated Manifestation of č² (Test-Support Segment)

Purpose of Segment (Comparative Framing)

Relative to established cosmological and dynamical frameworks—including ΛCDM, MOND, Planck observational protocols, and SPARC-based structure analyses—this segment does not introduce new physical laws or empirical claims. Its purpose is to justify the **admissibility of photon-based observables** as indirect probes of the **Π**-constrained emergence framework developed in Segment I and tested empirically in Segment II. The tiered structure below is therefore comparative and supportive in nature, aligning with existing empirical baselines while clarifying constraint-based mediation rather than replacing established models.

Tier M_0 — Intrinsic Non-Flatness of č² (Non-Empirical Premise)

Statement

The pre-geometric substrate č² is intrinsically non-flat. This non-flatness is a structural property of the substrate itself and does not refer to curvature within any geometric or spacetime manifold.

Test-Relevance

This tier establishes the non-empirical premise required for all downstream manifestation. No direct observation is possible at this level; its validity is assessed exclusively through the coherence and necessity of subsequent tiers, consistent with pre-geometric assumptions employed in other emergent-spacetime approaches.

Tier M_1 — Recursive Residue and Pre-Geometric Angular Bias

Statement

Because č² is intrinsically non-flat, recursive processes do not fully cancel. A non-zero recursive residue necessarily persists. This residue constitutes a pre-geometric angular bias, defined as an ordering asymmetry that exists prior to spatial extension, temporal duration, or metric structure.

Test-Relevance
This tier introduces the minimal condition required for motion without invoking geometry. It constrains admissible emergence pathways and **excludes** models in which momentum arises solely from geometric interaction, a limitation that remains implicit but unaddressed in standard ΛCDM interpretations.

Tier M_2 — Momentum as a Pre-Geometric Inheritance

Statement
Angular bias implies momentum as a necessary consequence. Momentum is therefore not generated within geometry but inherited from unresolved pre-geometric recursion.

Test-Relevance
This tier fixes momentum as an inherited quantity rather than an emergent geometric artifact. Any empirical observable involving momentum must therefore be compatible with inheritance rather than local generation, a distinction **consistent with** established conservation practices while constraining interpretive freedom relative to purely geometric accounts.

Tier M_3 — Photon as a Candidate Admissible Carrier into X^2

Statement
The photon is **proposed here as** the first admissible carrier capable of expressing inherited momentum within the geometric domain X^2. Its defining properties—massless propagation, intrinsic angular momentum, invariance of speed, and universality of interaction—are **treated as consistent with** this role under the admissibility constraints of the framework.

Test-Relevance
This tier **provides interpretive support** for treating the photon as an empirical interface between pre-geometric origin and

geometric observables. Photon-based measurements are therefore **used illustratively** as admissible probes of inherited momentum structure, consistent with established empirical practice in ΛCDM cosmology, Planck-based inference pipelines, and standard quantum electrodynamics.

Falsification and validation of the framework remain confined to Tier-1 and Tier-2 outputs.

Tier M_4 — Electromagnetic Interaction as Observable Expression

Statement
Electromagnetic interaction is the observable expression of photon-borne momentum within X^2. Propagation, polarization, radiation pressure, and energy transfer are downstream manifestations of the same inherited momentum.

Test-Relevance
This tier connects directly to empirical tests. Observables involving electromagnetic phenomena—cosmic microwave background anisotropies and polarization, radiative processes in structure formation, and photon-based late-time diagnostics—serve as indirect tests of the inheritance chain established above, **relative to** Planck protocols and SPARC/RAR observational datasets.

Integration with the Test Architecture

The tiered manifestation defined in this segment legitimizes the empirical structure of the Test Report:

- **Tier 1 tests** (CMB initial conditions) probe photon-dominated early-universe behavior, consistent with Planck observational priorities.
- **Tier 2 tests** (structure response) involve electromagnetic and radiative processes, relative to SPARC and RAR phenomenology.
- **Tier 3 diagnostics** (late-time observables) rely entirely on photon propagation and interaction, as in standard cosmological practice.

Thus, while $\check{c}^2$ itself remains non-empirical, its intrinsic non-flatness becomes testable indirectly through the consistency of photon-mediated observables across all tiers.

Segment III Conclusion

Segment III positions photon-mediated observables as uniquely admissible probes under **Π**-constrained emergence. Relative to ΛCDM, MOND, Planck protocols, and SPARC-based analyses, this positioning remains fully compatible with established empirical practice while providing a constraint-based rationale for the tiered test architecture defined in Segment II. The photon is treated neither as a new postulate nor as an ontological substitute, but as the minimal, constraint-consistent mediator through which pre-geometric limitations become empirically accessible.

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6. Discussion and Scope Delimitation

This report is intentionally scoped as a **foundational framework and empirical test-architecture study**, rather than as a numerical results paper. Its primary objective is to establish the ontological structure of the General Theory of Entirety (GTOE), derive the projection constraint **Π** from the pre-geometric substrate, and define a disciplined, falsifiable pathway for empirical evaluation in the neo-geometric regime.

Several limitations are therefore **deliberate** rather than incidental. First, no executed quantitative fits are presented. While the statistical outputs, diagnostics, and comparison criteria are fully specified in Segment II and the Appendix, numerical execution is deferred to subsequent demonstration work. This separation is necessary to prevent premature parameterization before the admissible geometric class has been fixed.

Second, the latent pre-geometric substrate **č²** is not treated as an empirical object. It admits no direct observational access and is evaluated only through internal consistency and through the degree of constraint it imposes on emergent geometry. Empirical success or failure therefore bears on **č²** only **indirectly**, via the projection constraint **Π** and the admissible neo-geometric outcomes it permits.

Third, the tiered empirical structure defined in Segment II assigns different epistemic weight to different observables. Tier 1 (initial-condition observables, such as **CMB low-ℓ** behavior) and Tier 2 (structure response, such as galaxy rotation curves) are treated as **decisive** tests of the framework. Tier 3 (late-time diagnostics, including H_0, σ_8, and evolving dark energy) is treated as **supportive but non-decisive**, and is not permitted to retroactively alter constraints established at earlier tiers.

Finally, this report does not claim exclusivity or completeness. It defines a constrained admissibility framework and a transparent testing protocol, but does not preclude alternative pre-geometric approaches. Its scope is limited to demonstrating that if geometry emerges from a recursive substrate, it must do so within a tightly restricted structural class.

7. Conclusion

This report has articulated a structured empirical validation architecture for the General Theory of Entirety (**GTOE**), grounded in the foundational identity

$$\Sigma = \check{c}^{2}(0)^{1}$$

and operationalized through the projection constraint **Π**. By maintaining a strict separation between pre-geometric generation and neo-geometric empirical testing, the framework avoids category errors while remaining empirically accountable.

Segment I established that the projection constraint **Π** is not an ad hoc assumption, but a necessary consequence of recursive consistency, finite-depth admissibility, and restricted scaling freedom. The admissible neo-geometric class is therefore constrained at the level of structure, prior to any phenomenological fitting. A symbolic neo-geometric exemplar illustrated how **Π** acts on emergent quantities without introducing unconstrained functional freedom.

Segment II defined a tiered empirical testing program that fixes, in advance, the observables, diagnostics, and statistical criteria by which GTOE may be evaluated. This architecture ensures that future quantitative demonstrations will be decisive, reproducible, and comparable to standard geometric paradigms without parameter inflation.

Taken together, this report positions GTOE as a constrained, falsifiable framework for the emergence of geometry rather than as a phenomenological extension of existing models. The next stage of work consists of numerical implementation and data fitting within the boundaries fixed here. The validity of the framework will ultimately be determined by its performance against the specified empirical tiers.

8. References

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- **g.** Ambjørn, J., Jurkiewicz, J., & Loll, R. *The universe from scratch*. Contemporary Physics **47**, 103–117 (2006).
- **h.** Bombelli, L., Lee, J., Meyer, D., & Sorkin, R. *Space-time as a causal set*. Physical Review Letters **59**, 521–524 (1987).
- **i.** Penrose, R. *The Road to Reality*. Jonathan Cape (2004).
- **j.** Weinberg, S. *Cosmology*. Oxford University Press (2008).

9. Appendix (Data Sources and Statistical Protocols)

This appendix documents the observational data sources and statistical procedures referenced in the neo-geometric empirical test architecture defined in Segment II. No numerical execution or fitted results are presented here. The purpose of this appendix is to fix **data provenance, evaluation standards, and reporting protocols** in advance of quantitative implementation.

9.1 Observational Data Sources

Tier 1 — Cosmic Microwave Background (CMB)

Primary datasets for Tier-1 testing are drawn from publicly released CMB observations, with emphasis on large-scale (low-ℓ) behavior and acoustic peak structure.

- **Planck Legacy Archive (PLA)**
  Data products include temperature (TT), polarization (TE, EE), and low-multipole likelihoods from the final Planck releases. Focus regions:
  - Low-ℓ power suppression
  - Multipole alignments
  - Phase relationships between acoustic peaks

Only publicly available likelihoods and covariance matrices are used. No proprietary or unreleased datasets are assumed.

Tier 2 — Galaxy Rotation Curves

Primary datasets for Tier-2 testing are drawn from high-quality, resolved galaxy rotation curve compilations.

- **SPARC (Spitzer Photometry & Accurate Rotation Curves) Database**
  Includes rotational velocity profiles, baryonic mass distributions, and uncertainty estimates for disk galaxies spanning a wide mass range.

Analysis is performed on a per-galaxy basis, respecting observational error bars and reported systematics. No stacking assumptions are imposed unless explicitly stated.

Tier 3 — Late-Time Cosmological Diagnostics

Tier-3 diagnostics are treated as supportive and non-decisive.

Relevant datasets include:

- Local distance ladder measurements of the Hubble constant
- Large-scale structure and baryon acoustic oscillation surveys
- Publicly released dark-energy parameter reconstructions

Tier-3 results are interpreted diagnostically and do not independently determine the validity of the framework.

9.2 Statistical Evaluation Metrics

All empirical evaluation in this report's test architecture is confined to the **neo-geometric layer (X^2)**. No statistical fitting is performed on pre-geometric quantities.

The following metrics are specified for use in future numerical execution:

- **Goodness-of-fit statistics (X^2):**
  Used to quantify agreement between **Π**-constrained model predictions and observational data, accounting for reported uncertainties.
- **Model comparison criteria (AIC, BIC):**
  Used to compare **Π**-constrained models against baseline or extended geometric models while penalizing unnecessary parameters.
- **Uncertainty propagation:**
  All fits incorporate observational error bars and covariance where available. No visual or unweighted fits are permitted.

Reported results will include residuals, confidence intervals, and parameter sensitivity analyses.

9.3 Parameter Discipline and Constraints

The projection constraint **Π** restricts emergent neo-geometric behavior to a limited admissible class. Accordingly:

- No unconstrained functional freedom is allowed.
- All fitted parameters must have clear geometric or scaling interpretation.
- Effective parameter counts are reported explicitly for model comparison.

Late-time diagnostic parameters are not permitted to retroactively alter Tier-1 or Tier-2 constraints.

9.4 Reproducibility and Transparency

All numerical implementation will adhere to the following standards:

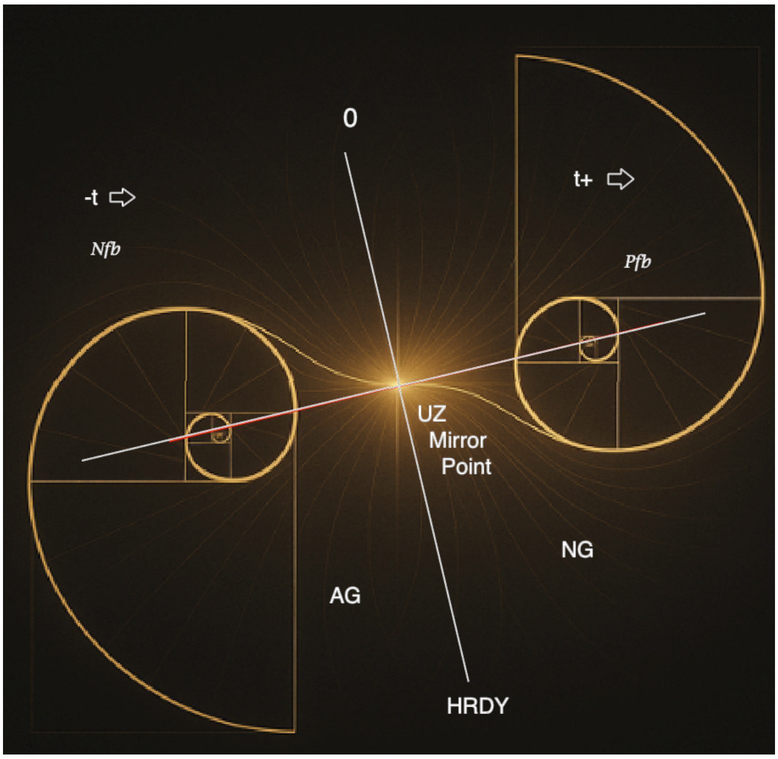
- Exclusive use of publicly accessible datasets
- Explicit documentation of preprocessing steps
- Clear separation between symbolic framework development and numerical execution
- Full reporting of statistical assumptions and comparison baselines

Code, scripts, or notebooks used for execution will be made available in a subsequent demonstration release.

Appendix Scope Note

This appendix defines **procedural commitments**, not results. Its purpose is to ensure that future empirical demonstrations are reproducible, auditable, and aligned with the framework boundaries established in the main body of this report.

10. Explanation of Cover Image



The General Theory of Entirety proposes that the observable universe (**X²**) is derived from a rare pre-geometric condition produced by mirroring of the latent substrate **č²**, a regime in which neither space nor time exists. This derivation is governed by **Negative Fibonacci recursion (N*fb*)**, which constitutes the necessary inward, contractive process from which any outward generative structure may arise. The emergence of **Positive Fibonacci expansion (P*fb*)**—and hence observable geometric order—is impossible without this prior negative recursion.

Although its ultimate capacity to interpret past and future states through angular division has not yet been specified, the instantaneous convergence of these two recursive regimes defines Entirety itself. The illustration is schematic and symbolic, intended to represent ontological structure of The Theory of Entirety in General.

Last updated: December 22, 2025 by GTOE author.

Detailed **Π** derivation and quantitative fits forthcoming.
