Formal Derivation of $D - \psi - G$ Trinity

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2025

1 Three Descriptive Paradigms of Information

Building on the ontological equivalence of physical and informational configurations established in Paper I, we identify three irreducible descriptive paradigms of information sufficient for representing bounded, persistent observers:

1. Discrete (set-theoretic),
2. Analytical (spectral, wavefunction compressed),
3. Geometric.

These paradigms are mutually equivalent, descriptively irreducible, and jointly sufficient to express all internally meaningful informational structure. Physical theories may privilege one paradigm for convenience, but no paradigm is fundamental. The consistency between them replaces the role traditionally assigned to physical laws.

This triadic structure provides a foundation for unifying quantum theory, spacetime geometry, and information theory within a single informational framework.

Translations between these paradigms preserve informational content but not descriptive primitives. This establishes their equivalence without ontological hierarchy.

2 Hypothesis

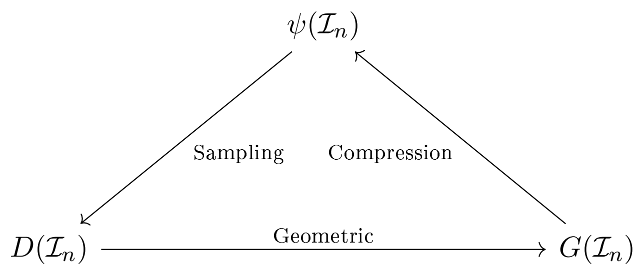
We hypothetize that observers emerge as configurations that are simultaneously well-defined across all three paradigms.

1. The analytic (wavefunction) ensures existence with high measure (optimal compression algorithm)
2. The discrete (particles) is the finite rasteriation of the wavefunction.

3. The geometric ensures separation, persistence, and identity (the only known mechanism for implementing an inside–outside invariant).

The three paradigms act as orthogonal functional roles, not alternative encodings of the same role.

3 $D - \psi - G$ Formalism



Cycle-Consistency Conditions

We now formalize the functional consistency of the D–ψ–G cycle. Let Π_D, Π_G, and Π_ψ denote the projections from wavefunction to discrete, discrete to geometric, and geometric back to wavefunction representations, respectively. The cycle is unidirectional:

$$\psi(\mathcal{I}_n) \xrightarrow{\Pi_D} D(\mathcal{I}_n) \xrightarrow{\Pi_G} G(\mathcal{I}_n) \xrightarrow{\Pi_\psi} \psi(\mathcal{I}_n)$$

We require that each vertex is approximately preserved under a full cycle:

$$\Pi_\psi \circ \Pi_G \circ \Pi_D\big(\psi(\mathcal{I}_n)\big) \approx \psi(\mathcal{I}_n), \tag{1}$$
$$\Pi_G \circ \Pi_D \circ \Pi_\psi\big(G(\mathcal{I}_n)\big) \approx G(\mathcal{I}_n), \tag{2}$$
$$\Pi_D \circ \Pi_\psi \circ \Pi_G\big(D(\mathcal{I}_n)\big) \approx D(\mathcal{I}_n). \tag{3}$$

Here, "$\approx$" reflects the fact that some information is necessarily compressed, discretized, or projected in each step. This small deviation is *not a flaw*, but the very source of emergent dynamics:

- The geometric–discrete projection encodes persistence and boundaries; subtle misalignments create effective forces and interactions in G (e.g., gravitation, shape deformation).
- The discrete–wavefunction projection re-compresses the observer and environment; slight differences drive the temporal evolution of the wavefunction, producing trajectories in ψ.
- Successive cycles of $\psi \to D \to G \to \psi$ propagate these deviations, giving rise to all observed dynamics, from particle motion to human behavior, entirely as a consequence of MDL-driven reconstruction.

In this view, dynamics emerges from the continuous *compression–decompression cycle* that preserves observer-defining information while allowing minimal deviations. Observers are thus inherently stable yet dynamically active, their evolution encoded in the small, structured differences accumulated across successive cycles.

Each vertex of the triangle represents a mutually equivalent projection of the same underlying informational configuration space $\mathcal{I}_n$:

- $D(\mathcal{I}_n)$: discrete representation,
- $\psi(\mathcal{I}_n)$: analytic representation,
- $G(\mathcal{I}_n)$: geometric representation.

Connecting lines are structure-preserving maps connecting the representations. The curved arrows illustrate invertible, commuting transformations between representations. The diagram formalizes that no representation is fundamental; all are mutually consistent projections of the same informational object.

4 Paradigms and Descriptions

4.1 1. Analytic Representation (ψ)

Observer Emergence Principle (Spectral Form): Among the ensemble of all possible wavefunctions Ψ over configuration space $\mathcal{C}$, the observer-compatible paths $\gamma \in \mathcal{T}_{\mathrm{obs}}$ are overwhelmingly likely to occur in the *minimal-length* wavefunctions, due to algorithmic (Salomonoff) weighting:

$$\Psi(\gamma) \propto 2^{-\mathcal{L}(\gamma)/2},$$

where $\mathcal{L}(\gamma)$ is the minimal spectral encoding length of γ. High-entropy, incompressible wavefunctions exist but carry exponentially negligible measure; thus, the observer emerges almost certainly in the simplest, smoothest, low-entropy wavefunctions.

$$\mathcal{T}_{\text{obs}} = \{\gamma \in \mathcal{S} \mid \text{Observer}(\gamma) = 1\}$$

(Same observer paths from D; basis for compression)

$$\downarrow$$

$$\mathcal{L}(\gamma) = \text{Minimal spectral encoding length of } \gamma \in \mathcal{T}_{\text{obs}}$$

(Wavefunction as compression: smooth, predictable, low-entropy paths favored)

$$\downarrow$$

$$\Psi(\gamma) = \frac{2^{-\mathcal{L}(\gamma)/2}}{\sqrt{\sum_{\gamma' \in \mathcal{T}_{\text{obs}}} 2^{-\mathcal{L}(\gamma')}}}$$

(Normalized wavefunction: encodes all observer-compatible paths)

$$\downarrow$$

$$P(\gamma) = |\Psi(\gamma)|^2$$

(Born measure: relative likelihood of path γ)

$$\downarrow$$

$$\delta \int_\gamma \mathcal{L}(\text{state})\, d\lambda = 0 \implies \text{Geodesics}$$

(Minimal-description principle produces paths identical to classical action extrema)

4.2 2. Discrete Representation (D)

$$\mathbf{P} = \text{Raw informational potential}$$

(Infinite unstructured possibilities; no preferred encoding)

$$\downarrow$$

$$\mathcal{C} \cong \{0,1\}^{\leq \infty}$$

(Discrete configuration space; convenient static representation)

$$\downarrow$$

$$\mathcal{S} = \{(s_1, \ldots, s_T) \mid s_i \in \mathcal{C}\}$$

(Space of all finite/semi-infinite paths through configuration space)

$$\downarrow$$

$$\mathcal{T}_{\text{obs}} = \{\gamma \in \mathcal{S} \mid \text{Observer}(\gamma) = 1\}$$

(Observer Filter: selects paths with stable informational recursion)

$$\downarrow$$

$$\mathcal{L}(\gamma) = \text{Minimal spectral encoding length of } \gamma \in \mathcal{T}_{\text{obs}}$$

(Compression–geometry duality: favors smooth, predictable, and compressible histories)

$$\downarrow$$

$$\Psi(\gamma) = \frac{2^{-\mathcal{L}(\gamma)/2}}{\sqrt{\sum_{\gamma' \in \mathcal{T}_{\text{obs}}} 2^{-\mathcal{L}(\gamma')}}}$$

(Spectral realization: wavefunction encodes optimal compression of observer paths)

$$\downarrow$$

$$P(\gamma) = |\Psi(\gamma)|^2$$

(Born measure: relative probability of experienced histories)

$$\downarrow$$

4.3 3. Geometric Representation G

$$\mathcal{T}_{\text{obs}} \subset \mathcal{S}$$

(Observer-compatible paths through configuration space)

$$\downarrow$$

$$\mathcal{I}(\gamma_\lambda) \xrightarrow{\Pi_G} \mathcal{M}_\lambda \subset \mathbb{R}^d$$

(Geometric projection λ)

$$\downarrow$$

$$\rho(\mathbf{s}) \sim \text{Lognormal}(\mu, \sigma^2)$$

(Emergent density variations from reusable microstructure)

$$\downarrow$$

$$\delta \int_\gamma \mathcal{L}(\text{state})\, d\lambda = 0 \implies \text{Geodesics}$$

(Gravitation as geometric manifestation of compression pressure; GR emerges from observer-consistent paths)$\delta \int_\gamma \mathcal{L}_{\text{geom}}\, d\lambda$

(Geodesics as minimal-description trajectories)