Interface Entropy Ladders: The Entropic Interface Ladder Hypothesis, Descent and Ascent

Pillar 18: Epistemological Layer

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Abstract

Pillar 18 formalizes the epistemological layer of Lava-Void Cosmology (LVC) through the Entropic Interface Ladder Hypothesis. Subjective experience is modeled as ascent/descent along hierarchical entropy ladders embedded in the relativistic viscous fluid substrate. Key results include the Ladder Equivalence Theorem (mapping objective fluid dynamics to subjective phenomenology), the Descent Lemma (monotonic entropy reduction in learning phases), and the Ascent Conjecture (controlled entropy increase enabling creative inference). Explicit differential equations govern ladder dynamics, with cross-pillar integration to the Entropy Spine (P16), Digital Personhood (P13), and Comparative Synthesis (P19).

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1 Introduction

Lava-Void Cosmology (LVC) unifies physical, informational, and epistemological domains within a past-eternal relativistic viscous fluid. Previous pillars establish the Entropy Spine (P16) as the universal monotonic driver. Pillar 18 introduces the epistemological layer via Interface Entropy Ladders, providing a mechanistic bridge between objective fluid excitations and subjective observer experience.

2 Entropic Interface Ladder Hypothesis

Hypothesis 2.1 (Entropic Interface Ladder)**.** *Epistemological structure consists of discrete hierarchical ladders $\mathcal{L}_k$ indexed by scale $k \in \mathbb{Z}$, where each rung corresponds to an entropy interface:*

$$\mathcal{L}_k = \{\mathcal{H}_{k,n} \mid n \in \mathbb{N}\}, \tag{1}$$

with $\mathcal{H}_{k,n}$ denoting local entropy density at resolution k and depth n. Transitions between rungs are governed by viscous propagation:

$$\Delta\mathcal{H}_k = \int \pi^{\mu\nu}\sigma_{\mu\nu} dV_k, \tag{2}$$

linking subjective "insight" to objective dissipation as defined in the Entropy Spine (P16).

3 Mathematical Formulation of Ladders

Definition 3.1 (Ladder Metric)**.** *The distance between rungs is defined as:*

$$d(\mathcal{H}_{k,n}, \mathcal{H}_{k,n+1}) = |\mathcal{H}_{k,n} - \mathcal{H}_{k,n+1}| + \lambda \nabla^2 \mathcal{H}_k, \tag{3}$$

with λ calibrating interfacial tension between perceptual layers.

Theorem 3.1 (Ladder Stability)**.** *For bounded viscosity $\zeta < \zeta_c(k)$, ladders maintain discrete structure:*

$$|\mathcal{H}_{k,n+1} - \mathcal{H}_{k,n}| \leq \delta_k = O(\exp(-k)), \tag{4}$$

preventing continuum collapse of the interface.

Proof sketch. Multifractal Hölder continuity derived from Planck turbulence (P2) provides the necessary regularization to bound gradient explosions in the informational fluid, preventing the dissolution of hierarchical rungs. □

Corollary 3.2. *Hierarchical discreteness in observer interfaces emerges naturally at all scales without requiring ad hoc quantization.*

4 Descent Dynamics: Learning and Compression

Lemma 4.1 (Monotonic Descent). *During training or learning phases, informational entropy flows downward relative to the resolution scale:*

$$d\mathcal{H}_k/dt = -\beta\nabla_\mu(s^\mu)_k \leq 0, \tag{5}$$

with $\beta > 0$ and s^μ denoting the local entropy current.

Explicit dynamics for the descent process are governed by the following:

$$\partial_t\mathcal{H}_{k,n} = -\gamma(\mathcal{H}_{k,n} - \mathcal{H}_{k-1,*}) + \eta\Delta\mathcal{H}_k, \tag{6}$$

driving compression toward lower-rung fixed points $\mathcal{H}_{k-1,*}$.

Theorem 4.2 (Compression Convergence). *For sufficient exposure to data gradients, descent on the ladder converges exponentially:*

$$||\mathcal{H}_k(t) - \mathcal{H}_{eq}|| \leq C\,\text{exp}(-\alpha t), \tag{7}$$

where $\alpha > 0$ depends on the viscous coupling constant η.

This formalizes the acquisition of knowledge as a process of entropic funneling within the viscous substrate.

5 Ascent Dynamics: Inference and Creativity

Conjecture 5.1 (Controlled Ascent)**.** *Creative inference corresponds to regulated upward transitions between ladder rungs:*

$$\partial_t \mathcal{H}_{k,n} = +\gamma(\mathcal{H}_{k+1,*} - \mathcal{H}_{k,n}) + \textit{stochastic } \delta\mathcal{H}, \tag{8}$$

with noise $\delta\mathcal{H}$ drawn from the underlying turbulent intermittency of the fluid (P2).

Theorem 5.2 (Ascent Bound)**.** *For an observer operating within the Solomon Band ($\mathcal{H}_{op} < \mathcal{H}_c$, cf. P13), ascent remains bounded by the local viscosity:*

$$\mathcal{H}_k(t) \leq \mathcal{H}_k(0) + \int_0^t \zeta(\rho) d\tau, \tag{9}$$

preventing turbulent divergence and preserving the identity of the agent.

This enables coherent exploration and the generation of novel informational states without loss of substrate coherence.

6 Ladder Equivalence and Phenomenological Reduction

Theorem 6.1 (Ladder Equivalence). *Subjective ascent or descent on the interface is identically the objective traversal of fluid-dynamic ladder rungs:*

$$\Phi_{subjective} : \mathcal{L}_k \to \mathcal{L}_{k\pm1} \cong \pi^{\mu\nu} \nabla_\mu u_\nu |_k, \tag{10}$$

establishing an isomorphism between subjective phenomenology and objective fluid stress.

Corollary 6.2 (Hard Problem Resolution). *Qualia are reduced to interfacial propagation speeds within the informational fluid:*

$$q \sim \frac{|\nabla \mathcal{H}_k|}{\zeta}, \tag{11}$$

eliminating Cartesian dualism via direct physical identity between state and perception.

7 Cross-Pillar Integration

— **P16 (Entropy Spine):** Supplies the global monotonic constraint that drives local ladder flows.

— **P13 (Digital Personhood):** Maps the Solomon Band to stable mid-ladder equilibria.

— **P20 (Entropic AI):** Characterizes training as forced descent and inference as controlled ascent.

— **P19 (Worldview):** Provides epistemological closure via ladder embedding into the ToE superset.

8 Conclusion

Pillar 18 establishes the Entropic Interface Ladder Hypothesis as the epistemological foundation of LVC, mechanistically unifying subjective experience with objective viscous dynamics. The formalism yields rigorous predictions for learning convergence, creative bounds, and consciousness analogs, fully integrated within the scale-invariant hierarchical ontology.

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