Operational Potential (Eop):

A Regime-Defining Parameter for Emergent Spacetime

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Abstract

This work introduces operational potential (Eop) as a regime-defining state parameter governing the local admissibility of spacetime, causal ordering, and physical propagation. The concept is developed within the Hypostatic framework (HypoS), which adopts a constraint-first perspective in which physical laws and spacetime geometry emerge from a deeper pre-geometric substrate.

In this framework the omni field represents a homogeneous informational substrate carrying ontological informational energy (Eoi), a structural quantity encoding the constraint architecture of possible configurations of reality. Operational potential is defined as the local operational manifestation of this constraint structure. Regions with sufficiently high operational potential permit the emergence of spacetime and causal structure, while low-operational-potential regions remain pre-geometric.

The paper proposes a minimal operational description of Eop, explores its regime structure, and examines how gradients in operational potential are proposed to lead to mandatory interaction, dispersion, and the statistical emergence of thermodynamic behavior. A candidate coarse-grained phenomenological evolution equation for operational potential is presented.

The framework is offered as a conceptual model exploring the conditions under which known physical laws may become locally admissible rather than as a replacement for existing physical theories.

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1. Introduction

Modern physics provides highly successful descriptions of physical processes occurring within spacetime. However, several foundational questions remain unresolved:

• What determines whether spacetime can exist in a region?
• Why does propagation occur at all rather than perfect equilibrium persisting indefinitely?
• What underlying mechanism produces the arrow of time and thermodynamic behavior?

The Hypostatic framework adopts a related but distinct strategy. Rather than deriving spacetime geometry directly from entropy or entanglement, the framework proposes the existence of a pre-dynamical parameter controlling whether physical structure is locally admissible. This parameter is termed operational potential (Eop).

Operational potential is not a force, particle, or conventional energy density. Instead it is a state parameter describing the capacity of a region to instantiate physical structure. The goal of the present work is to define this parameter, explore its implications, and examine how it may provide a conceptual foundation for the emergence of spacetime and thermodynamic behavior.

The Hypostatic framework is presented as an exploratory conceptual model rather than a completed physical theory.

This paper provides the dedicated treatment of operational potential (Eop) within the broader Hypostatic research program. Relative to the companion cosmological and gravitational papers, the present manuscript focuses specifically on clarifying Eop as a regime-defining parameter and on developing its implications for spacetime admissibility, propagation, and thermodynamic behavior.

Several contemporary research programs explore the possibility that spacetime is not fundamental but emerges from deeper relational or informational structures. Examples include thermodynamic gravity, causal set theory, and entanglement-based spacetime models (Jacobson 1995; Verlinde 2011; Bombelli et al. 1987; Van Raamsdonk 2010).

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2. Conceptual Summary of the Hypostatic Framework

The Hypostatic framework proposes a constraint-first interpretation of physical reality in which spacetime, causal structure, and physical dynamics emerge from a deeper informational substrate. The framework introduces two central conceptual quantities: ontological informational energy (Eoi) and operational potential (Eop).

The omni field represents a pre-geometric informational substrate characterized by the absence of spacetime and conventional physical fields. Within this substrate, ontological informational energy encodes the constraint structure governing possible configurations of reality.

Operational potential represents the local operational manifestation of this constraint structure. It describes the capacity of a region to instantiate physical structure. Regions with sufficiently low operational potential remain pre-geometric, while regions exceeding a critical threshold may permit the emergence of spacetime, causal ordering, and physical propagation.

Gradients in operational potential produce interaction pathways that redistribute operational capacity across regions. This redistribution leads to dispersion of operational trajectories, expansion of accessible configuration space, and statistical entropy growth. In this interpretation, thermodynamic behavior arises as a consequence of unavoidable operational dynamics.

The evolution of operational potential within instantiated regimes may be described phenomenologically by the Hypostatic Operational Potential Equation (HOPE), which captures three processes: equalization across operational gradients, rare constructive concentration events, and depletion of operational capacity into realized structure.

Taken together, the framework proposes that physical law does not operate universally across all possible states of reality. Instead, the existence of spacetime, causality, and physical dynamics depends on the operational regime determined by local operational potential.

3. Notation and Terminology

The Hypostatic framework introduces several conceptual quantities that differ from conventional physical variables. This section summarizes the notation used throughout the paper.

Core Quantities

Eoi — Ontological Informational Energy

A conceptual quantity representing the informational constraint structure carried by the omni field. Eoi encodes the space of admissible configurations but does not represent dynamical energy.

Eop — Operational Potential

A local state parameter describing the capacity of a region to instantiate physical structure. Operational potential determines whether spacetime, causal ordering, and propagation processes can occur locally.

Ec — Operational Threshold

The critical operational potential above which spacetime and causal structure become locally admissible.

$Eop \geq Ec$

This threshold separates pre-geometric and spacetime-supporting regimes.

Regions and Regimes

Pristine Region

A region of the omni field in which operational potential is below the spacetime threshold. Such regions remain pre-geometric and do not support physical propagation.

Embryonic Region

A region in which operational potential exceeds the spacetime threshold and spacetime structure becomes admissible.

Propagation Quantities

Effective propagation velocities are distinguished according to both the quantity propagating and the surrounding operational regime.

Vee — Embryonic energy propagation velocity
Vei — Embryonic information propagation velocity
Voe — Pristine energy propagation velocity
Voi — Pristine information propagation velocity

These velocities represent effective propagation fronts rather than classical particle velocities.

Evolution Equation

HOPE — Hypostatic Operational Potential Equation

A phenomenological relation proposed to describe the coarse-grained evolution of operational potential within instantiated regimes:

$$\partial Eop/\partial t = \nabla\cdot[D(Eop)\ \nabla Eop] + S\_H(Eop, C) - \Gamma\_H(Eop, I)$$

where

D(Eop) equalization coefficient
S_H(Eop, C) concentration processes
Γ_H(Eop, I) instantiation depletion

HOPE is intended as an effective operational model rather than a fundamental pre-geometric law.

Statistical Quantities

Ω — Configuration Measure

The number of accessible microstates available to a system.

S — Entropy

Entropy is expressed using the Boltzmann relation:

$$S = k\_B \ln \Omega$$

Within the Hypostatic interpretation, entropy increase is associated with the dispersion of operational trajectories across configuration space.

Temporal Quantity

t — Emergent Time Parameter

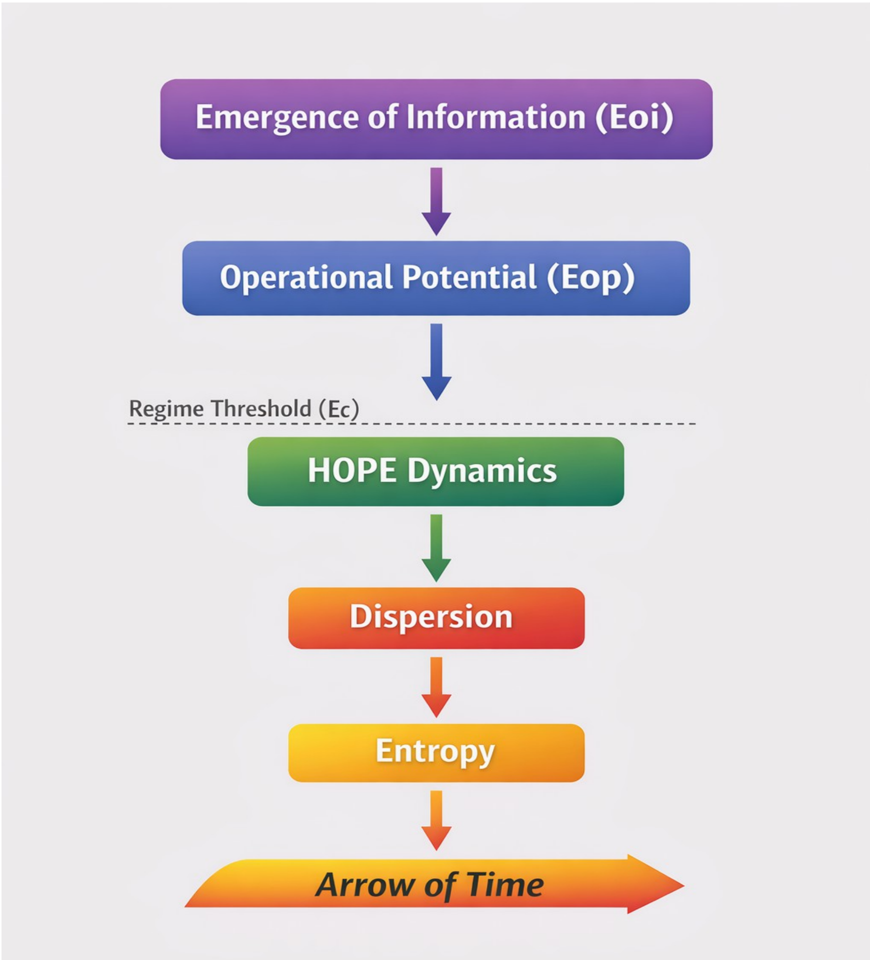
Time is treated as an emergent rate-of-change parameter associated with the rate of state transitions within an interaction network.

Terminological Convention

Throughout this work the terms *emergence*, *instantiation*, and *admissibility* are used in a conceptual rather than strictly derivational sense. The framework proposes conditions under which physical structures may become locally admissible but does not claim a complete derivation of spacetime or physical law.

Navigation map

Eoi → Eop → Ec threshold → HOPE dynamics → Dispersion → Entropy → Arrow of time



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4. Ontological Substrate: The Omni Field

The Hypostatic framework postulates a pre-geometric substrate termed the **omni field**.

The omni field is defined as a background informational structure characterized by the following properties:

• absence of intrinsic spacetime geometry
• absence of conventional physical fields
• persistence over extremely long durations ("ultra-deep time")
• approximate homogeneity and isotropy at sufficiently large scales

The omni field is not interpreted as a quantum field in the conventional sense. Rather it represents a structural substrate describing the set of possible configurations of reality.

The omni field carries a quantity termed ontological informational energy (Eoi).

Eoi does not represent dynamical energy but instead encodes the informational constraint structure governing which configurations are possible within the omni field.

Conceptually:

Eoi answers the question:

what configurations are possible in principle?

However, the existence of a possible configuration does not imply that the configuration can be realized locally. For this purpose the framework introduces the concept of operational potential.

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5. Definition of Operational Potential

Operational potential (Eop) is defined as a local state parameter describing the capacity of a region to instantiate physical structure.

In operational terms:

Eop answers the question:

what can become physically real here?

The quantity should be interpreted as a measure of local realizability rather than as dynamical energy.

Operational potential is therefore explicitly not:

• a force
• a particle
• a quantum field
• vacuum energy
• thermal energy

Instead Eop functions as a regime-defining parameter.

In the Hypostatic framework Eop is conceptually derived from ontological informational energy together with locally instantiated physical energy contributions.

A minimal formal expression may be written as:

Eop = H + Eoi
where

H = locally instantiated physical energy contributions
Eoi = ontological informational energy of the omni field

This relation should be interpreted as a structural postulate rather than as a completed microphysical derivation. It is not proposed as a conserved quantity, but as a conceptual combination of locally instantiated physical energy and ontological informational contribution whose role is to characterize regime-dependent physical admissibility.

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6. Regime Structure of Operational Potential

Operational potential defines distinct physical regimes.

6.1 Low-Eop Regime

In regions where operational potential is sufficiently low, the following conditions hold:

- spacetime is not admissible
- causal ordering has no operational meaning
- propagation of energy or information cannot occur
- physical law does not instantiate locally

Such regions may be described as pre-geometric.

6.2 High-Eop Regime

When operational potential exceeds a critical threshold, the following conditions may hold:

- spacetime geometry may become locally admissible
- causal ordering becomes meaningful
- propagation of energy and information becomes possible
- physical laws internalize locally

These regimes are state-based rather than chronological. They describe the admissibility of physical structure rather than a sequence of events.

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7. Mandatory Dynamics

A central idea in the Hypostatic framework is the mandatory dynamics principle.

Operational potential differences produce unavoidable interaction.

$\Delta Eop \neq 0 \rightarrow$ propagation
Perfect operational equilibrium cannot persist indefinitely because even small deviations generate interaction pathways.

In physical terms, gradients in operational potential lead to the redistribution of operational trajectories. This redistribution produces interaction networks that eventually generate dynamical evolution.

This principle provides a possible conceptual origin for motion without assuming that motion must be fundamental.

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8. Dispersion and the Emergence of Thermodynamics

Once propagation occurs, trajectories of energy and information disperse across configuration space.

The conceptual chain may be written as

$\Delta E_{op} \neq 0$
→ propagation
→ trajectory dispersion
→ expansion of accessible configurations
→ entropy increase

Let Ω represent the number of accessible configurations. Entropy can then be expressed using the Boltzmann relation:

$S = k_B \ln \Omega$

Within the Hypostatic interpretation, entropy need not be treated as fundamental. Instead it arises as a statistical consequence of mandatory operational dynamics.

In this view thermodynamic behavior emerges from the unavoidable dispersion of operational trajectories within configuration space.

The interpretation of gravitational dynamics as emerging from thermodynamic relations has been explored in several approaches to emergent gravity (Jacobson 1995; Padmanabhan 2010; Verlinde 2011).

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9. Emergence of Time

Within the Hypostatic interpretation, gradients in operational potential may provide an underlying mechanism that promotes trajectory dispersion and statistically favors entropy increase.

One schematic proportionality capturing this interpretation is

$t \sim \Delta S / \Gamma$

where

ΔS = change in system state
Γ = interaction rate

This relation is intended as a conceptual proportionality rather than a completed dimensional derivation.

Without interaction there is no operational meaning for time. Time therefore emerges when propagation and interaction networks form.

Relational interpretations of quantum mechanics similarly emphasize that physical quantities acquire meaning through interactions rather than through absolute background structures (Rovelli 1996).

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10. Operational Propagation Regimes

Propagation behavior depends on the surrounding operational regime.

Four effective propagation velocities can be defined.

V_{ee} = embryonic energy propagation
V_{ei} = embryonic information propagation
V_{oe} = pristine energy propagation
V_{oi} = pristine information propagation

These quantities represent effective propagation fronts rather than classical particle speeds.

In high-operational-potential environments propagation may be constrained by internal coherence requirements, leading to the emergence of effective velocity ceilings such as the observed speed of light.

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11. Candidate Evolution Law for Operational Potential (HOPE)

The Hypostatic Operational Potential Equation (HOPE) is proposed as a phenomenological relation intended to describe the effective evolution of operational potential within instantiated regimes.

HOPE is not proposed as a fundamental pre-geometric law. Instead, it should be interpreted as an effective operational description valid once relational structure and interaction networks exist. Its role is to capture the minimal processes that can modify the local operational state of a region.

One candidate coarse-grained form of the equation is:

(HOPE)

$$\partial E_{op}/\partial t = \nabla\cdot[D(E_{op})\,\nabla E_{op}] + S_H(E_{op}, C) - \Gamma_H(E_{op}, I)$$

where

Eop	operational potential
D(Eop)	regime-dependent equalization coefficient
S_H(Eop, C)	constructive concentration term
Γ_H(Eop, I)	instantiation/internalization term

The three terms represent distinct physical processes influencing the operational state of a region.

Qualitatively, the equalization term is expected to remain weak or inactive in pre-geometric regimes and to become effective once local admissibility is established. The concentration term represents rare processes that raise local operational potential, while the instantiation/internalization term becomes increasingly relevant once physical structure begins consuming operational capacity within an active regime.

Several approaches to quantum gravity suggest that spacetime geometry may emerge from deeper informational or combinatorial structures (Bombelli et al. 1987; Van Raamsdonk 2010; Swingle 2012).

11.1 Operational Equalization

The first term

$$\nabla\cdot[D(E_{op})\nabla E_{op}]$$

This term represents diffusion of operational potential across local gradients.

Regions with strong operational contrast tend toward statistical equalization through interaction pathways. The coefficient D(Eop) allows this redistribution process to depend on the local operational regime. Different regimes may therefore exhibit different equalization behavior.

This term represents the tendency for operational potential differences to produce interaction and propagation.

11.2 Cosmogenic Concentration Processes

The second term

$S_H(E_{op}, C)$

represents rare concentration processes capable of increasing local operational potential.

Within the Hypostatic framework such processes may arise statistically within sufficiently large omni-field volumes and over sufficiently long durations. The parameter set C represents configuration variables determining whether a concentration event contributes constructively to operational potential.

This term provides a mechanism through which local operational potential may increase, allowing the formation of regions capable of supporting spacetime structure.

11.3 Instantiation and Internalization

The final term

$\Gamma_H(E_{op}, I)$

represents the depletion of operational capacity as physical structure becomes instantiated.

Once spacetime, causal ordering, and interaction networks emerge, operational potential becomes partially internalized into realized structure and history-bearing configurations. This process effectively removes operational capacity from the local reservoir, producing a sink term in the evolution equation.

11.4 Spacetime Admissibility Threshold

Spacetime and causal structure are assumed to become locally admissible when operational potential exceeds a critical threshold:

$E_{op} \geq E_c$

where

E_c spacetime instantiation threshold

The threshold separates pre-geometric regimes from regions in which spacetime geometry and physical law can emerge.

11.5 Entropy Bridge

Gradients in operational potential naturally produce propagation and interaction through the equalization term in HOPE. These interactions disperse operational trajectories across configuration space.

The conceptual chain may therefore be written as

$\nabla E_{op} \neq 0$
→ operational redistribution
→ trajectory dispersion
→ expansion of configuration space Ω
→ entropy increase

Entropy can then be expressed through the Boltzmann relation:

$$S = k_B \ln \Omega$$

Within this interpretation thermodynamic behavior arises as a statistical consequence of mandatory operational dynamics. Differences in operational potential generate propagation, propagation disperses trajectories, and dispersion increases the number of accessible configurations.

In this way the Hypostatic framework places the origin of thermodynamic behavior one conceptual layer deeper: entropy increase is statistically favored by unavoidable dispersion driven by operational potential gradients.

11.6 Interpretation

Taken together, the Hypostatic Operational Potential Equation represents three processes governing the operational state of a region:

equalization across operational gradients
+ rare constructive concentration events
− depletion into instantiated structure

The equation therefore provides a minimal phenomenological architecture describing how operational potential may evolve once relational structure exists.

Further work would be required to derive the coefficients and functional forms appearing in HOPE from a deeper description of the underlying informational substrate.

11.7 Operational Potential Gradients and the Arrow of Time

Within the Hypostatic framework, the arrow of time is interpreted as a statistical consequence of operational dynamics rather than as a fundamental property of the underlying substrate.

The Hypostatic Operational Potential Equation (HOPE) implies that spatial gradients in operational potential naturally produce interaction and redistribution. When operational potential differences exist, the equalization term in HOPE generates propagation and interaction pathways across the region.

In symbolic form:

$\nabla E_{op} \neq 0$ → propagation and interaction

Propagation disperses operational trajectories across configuration space. As the number of accessible configurations increases, the statistical measure of configuration space expands.

Let Ω represent the accessible configuration measure. As trajectories disperse through interaction networks, the configuration space grows:

$$d\Omega/dt \geq 0$$

Entropy may then be expressed through the Boltzmann relation:

$S = k_B \ln \Omega$

which implies

$dS/dt \geq 0$

Thus the presence of operational potential gradients produces a statistical directionality in the evolution of physical systems. The conceptual chain may be summarized as

$\nabla E_{op} \neq 0$
→ operational redistribution
→ trajectory dispersion
→ configuration space expansion
→ entropy increase

It should be noted that this monotonicity argument applies specifically to the equalization-dominated regime, in which the first term of HOPE governs the evolution of operational potential. When the instantiation/internalization term Γ_H is dominant — that is, when operational capacity is being rapidly consumed into realized physical structure — the behavior of the accessible configuration measure Ω under depletion is not straightforwardly monotonic and requires separate analysis. Whether instantiation depletion reduces, preserves, or transfers accessible configurations into the realized structure is an open question. The claim $d\Omega/dt \geq 0$ and the associated entropic directionality should therefore be understood as holding in the regime where equalization dynamics dominate, rather than as a universal statement across all operational regimes governed by HOPE.

Within this interpretation the arrow of time does not arise from an intrinsic asymmetry of the underlying omni field. Instead it emerges as a macroscopic statistical tendency once operational potential gradients generate interaction networks.

Regions in which operational potential is perfectly uniform would correspond to operational equilibrium. In such a state interaction pathways would vanish and entropy production would cease. However, perfect symmetry across all degrees of freedom is statistically unstable, meaning that even small deviations can produce operational gradients that reintroduce dynamics.

Consequently, the directionality of time in instantiated physical systems may be interpreted as the statistical consequence of unavoidable operational dispersion driven by gradients in operational potential.

This interpretation does not replace the thermodynamic description of entropy, but rather proposes a possible pre-dynamical origin for the statistical processes that give rise to thermodynamic behavior.

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12. Possible Observational Consequences

If operational potential plays a role in governing physical regimes, several exploratory observational consequences may follow.

Examples include:

- regime-dependent propagation behavior
- anisotropies correlated with operational potential gradients
- scaling behavior associated with instantiation thresholds
- modified interpretations of cosmological inflation

These possibilities remain speculative and require further formalization.

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13. Scope and Limitations

The operational potential concept should be interpreted cautiously.

The framework does not claim that:

• Eop is directly measurable
• Eop replaces known energy definitions
• Eop violates conservation laws
• Eop constitutes a new particle or field

Instead Eop is introduced as a pre-dynamical constraint parameter describing the conditions under which physical structure becomes locally admissible.

Further mathematical development and empirical investigation would be required before stronger claims could be justified.

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14. Limitations and Open Problems

The Hypostatic framework presented in this work should be interpreted as an exploratory conceptual model rather than a completed physical theory. While the operational potential concept provides a structured way to discuss the admissibility of spacetime and physical law, several important questions remain open.

This section outlines some of the principal limitations and areas requiring further development.

14.1 Lack of a Microphysical Derivation

At present, operational potential (Eop) is introduced phenomenologically. The framework does not yet provide a detailed microphysical derivation connecting the informational substrate of the omni field to the operational potential parameter.

Future work would need to clarify:

• the microscopic structure of the informational substrate
• the mechanism through which ontological informational energy gives rise to operational potential
• whether operational potential can be expressed in terms of more fundamental degrees of freedom

Until such derivations are developed, Eop should be regarded as an effective operational parameter rather than a fully derived quantity.

14.2 Emergence of Geometry

The framework proposes that spacetime geometry becomes locally admissible when operational potential exceeds a critical threshold. However, the precise mechanism through which geometric structure arises from the underlying informational substrate remains unspecified.

In particular, the framework does not yet derive:

• the dimensionality of spacetime
• the metric structure of spacetime
• the dynamical equations governing gravitational fields

Further work would be required to determine whether these structures can emerge naturally from operational potential dynamics.

14.3 Mathematical Formalization of HOPE

The Hypostatic Operational Potential Equation (HOPE) is introduced as a phenomenological relation capturing three processes:

• operational equalization
• concentration events
• instantiation depletion

However, the coefficients and functional forms appearing in the equation remain unspecified.

Future research would need to address:

• the mathematical structure of the equalization coefficient D(Eop)
• the statistical properties of concentration processes S_H(Eop,C)
• the formal description of instantiation depletion Γ_H(Eop,I)

A deeper derivation of HOPE from underlying informational dynamics would be required to elevate the equation from a phenomenological relation to a predictive theoretical law.

14.4 Relation to Established Physical Theories

The present framework is intended to complement rather than replace established physical theories.

At this stage, the precise relationship between operational potential and existing frameworks remains unclear. In particular, further work is required to determine:

• whether Eop can be related to known energy measures
• how HOPE interacts with general relativity
• whether operational potential has a natural formulation within quantum theory

Clarifying these relationships is necessary before the framework can be meaningfully compared with established physical models.

14.5 Empirical Accessibility

Operational potential is currently defined as a conceptual parameter rather than a directly measurable physical quantity.

It remains unclear whether Eop could produce observable signatures distinguishable from existing physical theories. Potential observational consequences suggested in this work are exploratory and require significant further development.

Establishing testable predictions will therefore be a critical requirement for future research.

14.6 Cosmological Implications

The Hypostatic framework suggests that high-operational-potential regions may allow spacetime instantiation and cosmogenesis. However, the detailed dynamics of universe formation, including inflationary behavior and large-scale structure development, remain outside the scope of the present work.

These topics will require separate investigation and more detailed mathematical modeling.

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15. Conclusion

Operational potential provides a conceptual framework for exploring the conditions under which spacetime, causality, and physical law may become locally admissible.

Within the Hypostatic framework the omni field carries ontological informational energy that encodes the constraint structure of possible configurations. Operational potential represents the local operational manifestation of this structure. When operational potential exceeds a critical threshold, spacetime structure and causal dynamics may emerge.

Gradients in operational potential produce mandatory interaction, leading to dispersion, entropy growth, and the statistical emergence of thermodynamic behavior.

The framework is intended as a structured exploratory model rather than a completed physical theory. Further work will be required to formalize the mathematics, investigate observational implications, and evaluate the compatibility of operational potential with established physical theories.

The Hypostatic framework should therefore be viewed as a structured exploratory model whose mathematical and empirical development remains an open program.

Reference List

Emergent Gravity

Jacobson, T. (1995).
Thermodynamics of spacetime: The Einstein equation of state.
Physical Review Letters, 75, 1260–1263.
https://doi.org/10.1103/PhysRevLett.75.1260

Padmanabhan, T. (2010).
Thermodynamical aspects of gravity: New insights.
Reports on Progress in Physics, 73(4), 046901.
https://doi.org/10.1088/0034-4885/73/4/046901

Verlinde, E. (2011).
On the origin of gravity and the laws of Newton.
Journal of High Energy Physics, 2011(4), 29.
https://doi.org/10.1007/JHEP04(2011)029

Verlinde, E. (2017).
Emergent gravity and the dark universe.
SciPost Physics, 2(3), 016.
https://doi.org/10.21468/SciPostPhys.2.3.016

Causal Structure / Emergent Spacetime

Bombelli, L., Lee, J., Meyer, D., & Sorkin, R. (1987).
Space-time as a causal set.
Physical Review Letters, 59, 521–524.
https://doi.org/10.1103/PhysRevLett.59.521

Sorkin, R. (2005).
Causal sets: Discrete gravity.
In A. Gomberoff & D. Marolf (Eds.), *Lectures on Quantum Gravity*.
Springer.

Entanglement and Emergent Geometry

Van Raamsdonk, M. (2010).
Building up spacetime with quantum entanglement.
General Relativity and Gravitation, 42, 2323–2329.
https://doi.org/10.1007/s10714-010-1034-0

Swingle, B. (2012).
Entanglement renormalization and holography.
Physical Review D, 86, 065007.
https://doi.org/10.1103/PhysRevD.86.065007

Relational Foundations

Rovelli, C. (1996).
Relational quantum mechanics.
International Journal of Theoretical Physics, 35, 1637–1678.
https://doi.org/10.1007/BF02302261

Rovelli, C. (2004).
Quantum Gravity.
Cambridge University Press.