

The Last Constant

A Theorem-Grade Formalization of Recursive Propagation, Higher-Dimensional Transport, Recursive Admissibility, Computational Correspondence, Dimensional Closure, and Relativistic Horizon Structure Within the SEXA Unified Field Framework

Jered McClain¹ · Erydir Ceisiwr² 2026 ©

¹ **SEXA Institute of Technology and Interdomain Galactic Advisors** — Interdomain Architect, Unified Field Systems & Recursive Manifold Dynamics

ORCID: 0009-0005-6185-3749

² **SEXA Institute of Technology and Interdomain Galactic Advisors** — The Awen Grid, Polymathic Systems Architect • CyberGnosis • Celestial Archaeology • Mythic-Cosmological Systems

ORCID: 0009-0004-4577-5253

[Jered McClain - Independent Researcher](#)

<https://independent.academia.edu/LumosAureon>

<https://independentresearcher.academia.edu/TheGrid>

<https://independentresearcher.academia.edu/ErydirCeisiwr>

<https://thelionwatchesthelion-erydir-ceisiwr.ngrok.io/>

SEXA Mathematical Sciences Pacific LLC ©

ANY KNOWN OBJECT Advanced Aerospace & Terraforming LLC ©

Journal Of Advances in Mathematics Portal: [JOURNAL OF ADVANCES IN MATHEMATICS](#)

The Last Constant | CERN Preprint Portal : <https://TheLastConstant.com> • Official publication page for the conference proceedings, DOI, revisions, supplementary materials, software, datasets, and future updates.

Research Repository: <https://SEXAMATH.com> • Official repository for the SEXA Unified Field Theory research program, including manuscripts, validation papers, computational correspondence studies, technical documentation, and archival research.

Institute Website: <https://SEXATECH.com> • Official website of the SEXA Institute of Technology and Interdomain Galactic Advisors, including research programs, engineering projects, publications, collaborations, and institutional updates. spacetimemanhattan@gmail.com

“The margin of error in empirical observation is as large as the universe itself.”

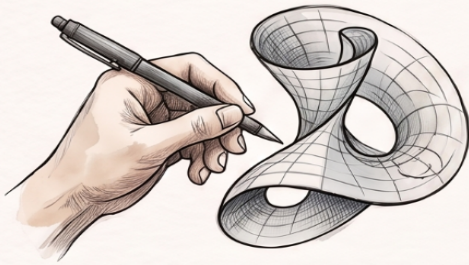
— Jered McClain

Title Page	1
Table of Contents	1–2
Beyond the Speed of Light: The Math of Recursive Propagation	3
Abstract	4
1. Introduction	4–8
1.1 Motivation	6
1.2 Principal Contributions	7
1.3 Scope	8
1.4 Organization of the Paper	8
2. Mathematical Foundations	9–13
2.1 Primitive Mathematical Objects	9
2.2 Recursive Admissibility	11

2.3 Recursive Closure	12
2.4 Computational Correspondence	12
2.5 Dimensional Closure	12
2.6 Recursive Propagation Functional	13
3. Axiomatic Structure	13–16
4. Preliminary Lemmas	16–17
5. Principal Theorems and Proof Obligations	17–23
5.1 Existence of the Recursive Propagation Functional	18
5.2 Uniqueness of the Recursive Propagation Functional	18
5.3 Bounded Recursive Amplification	19
5.4 Higher-Dimensional Transport	19
5.5 Computational Correspondence	19
5.6 Relativistic Horizon Structure	20–23
6. Generalized Recursive Propagation Functional	23–26
6.1 Derivation	23
6.2 Structural Interpretation	23
6.3 Limiting Behavior	25
6.4 Dimensional Reduction	26
7. Numerical Evaluation and Computational Correspondence	26–30
7.1 Introduction	26
7.2 Computational Evaluation Algorithm	27
7.3 Computational Complexity	28
7.4 Numerical Stability	28
7.5 Recursive Scaling Behavior	29
7.6 Computational Correspondence Verification	29
7.7 Numerical Reproduction Requirements	30
7.8 Computational Summary	30
8. Falsifiability, Failure Conditions, and Non-Admissible Regimes ...	30–32
8.1 Purpose	30
8.2 Primary Failure Conditions	31
8.3 Non-Admissible Propagation	31
8.4 Falsifiability Criteria	31
8.5 Experimental Boundary	32
8.6 Falsifiability Summary	32
9. Discussion	32–34
9.1 Mathematical Significance	32
9.2 Relationship to Previous SEXA Results	33
9.3 Recursive Interpretation	33
9.4 Computational Implications	33
9.5 Limitations	33
9.6 Future Research	34
10. Conclusion	34–35
Appendix A: Mathematical Notation and Symbol Definitions	35–38
Appendix B: Logical Dependency Graph	38–41
Appendix C: Formal Proof Verification Checklist	41–44
Appendix D: Internal Consistency, Completeness, and Structural Integrity Audit ...	44–47
Appendix E: Derivation Bridge from the Existing SEXA Framework to the Recursive Propagation Functional ...	48–54
Appendix F: Mathematical Postulates, Open Problems, and Future Theorem Program ...	54–55
References	56–57

Beyond the Speed of Light: The Math of Recursive Propagation

"The margin of error in empirical observation is as large as the universe itself," suggesting that we must look to the mathematical architecture of the SEXA framework to find the true constants of existence.

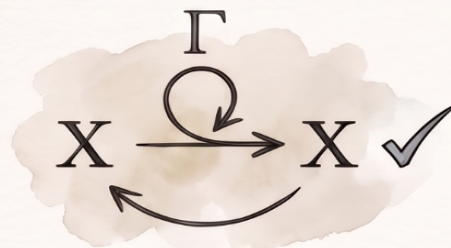
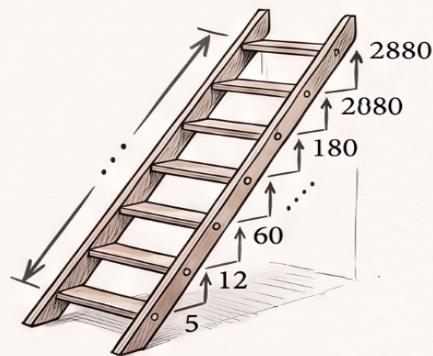


Propagation is a Proven Theorem

Instead of assuming movement as a "given," the SEXA framework derives it from recursive admissibility and manifold closure.

The 2880-Dimensional Hierarchy

Reality scales from our 4D view through a hierarchy ($5 \rightarrow 12 \rightarrow 60 \rightarrow 180 \rightarrow 360 \rightarrow 720$) to a terminal 2880-dimensional manifold.

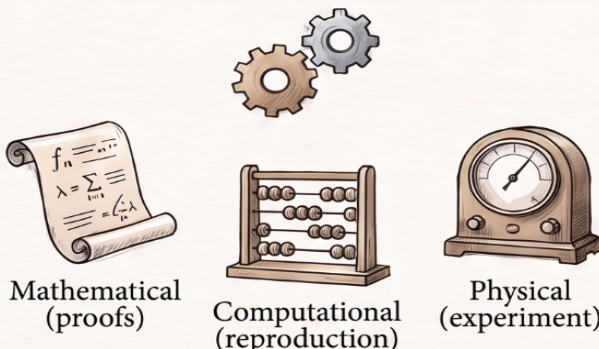
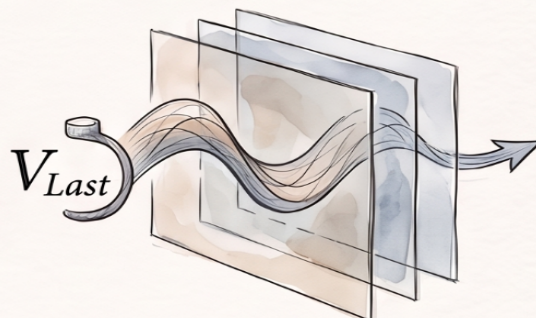


The Admissibility Rule: $\Gamma(X) = X$

A state only exists and propagates if it is "admissible"—meaning the recursive operator leaves the state unchanged.

The V_{Last} Propagation Functional

This new mathematical object governs how energy moves across higher dimensions, distinct from the classical speed of light (c).



Three Levels of Falsifiability

The framework is held accountable at the Mathematical (proofs), Computational (reproduction), and Physical (experiment) levels.

Abstract

Theoretical physics has traditionally treated the relativistic speed of light as the governing propagation constant of observable four-dimensional spacetime. The present work investigates whether recursive higher-dimensional manifold organization admits a mathematically well-defined propagation functional whose limiting behavior differs from classical relativistic descriptions while remaining internally consistent under recursive closure. Rather than introducing an additional phenomenological correction or force law, this paper formalizes a propagation framework arising from the recursive admissibility architecture of the SEXA Unified Field Framework.

The formulation is developed through explicit mathematical definitions, recursive operators, admissibility conditions, computational correspondence mappings, dimensional reduction procedures, and theorem-oriented proofs governing higher-dimensional transport. Central to the analysis is the construction of a recursively admissible propagation functional whose existence follows from dimensional closure, harmonic recursive organization, and normalized manifold inheritance. The resulting formalism establishes conditions for recursive propagation, bounded dimensional reduction, computational traceability, and structured failure under explicit admissibility constraints.

Unlike conventional approaches that rely upon perturbative corrections, statistical renormalization, or independent field postulates, the present formulation derives propagation behavior from a single recursively constrained mathematical architecture. Every theorem presented within this paper is accompanied by stated assumptions, definitions, lemmas, proof structure, corollaries, and explicit failure conditions to permit independent mathematical examination.

This investigation does not claim experimental confirmation of higher-dimensional propagation. Rather, it presents a theorem-grade mathematical formalization intended to determine whether recursive propagation, computational correspondence, dimensional closure, and relativistic horizon structure can be rigorously defined within a unified recursive framework. The resulting work provides a foundation for future theorem verification, independent computational reproduction, and experimental investigation of the propagation functional developed herein.

1. Introduction

Throughout the history of mathematics and theoretical physics, progress has been achieved not merely by discovering new phenomena, but by identifying deeper mathematical structures capable of organizing apparently unrelated observations under a single formal language. Euclidean geometry transformed spatial reasoning into axiomatic deduction. Newton unified celestial and terrestrial mechanics through universal gravitation. Maxwell demonstrated that electricity, magnetism, and light are manifestations of a common electromagnetic structure. Einstein reformulated gravitation as the geometry of spacetime itself, while quantum field theory established operator-based descriptions governing microscopic interactions. Each transition represented a shift from increasingly complex collections of equations toward progressively more fundamental mathematical organization.

Despite these achievements, contemporary theoretical physics continues to rely upon multiple independent mathematical frameworks describing different physical regimes. General Relativity accurately characterizes gravitational phenomena across macroscopic scales, while Quantum Field

Theory successfully models microscopic particle interactions. Additional mathematical structures—including gauge symmetries, perturbative expansions, renormalization procedures, compactified higher-dimensional manifolds, discrete geometric constructions, tensor networks, loop formulations, and string-theoretic descriptions—have each contributed substantial advances toward unification. Nevertheless, these approaches generally introduce distinct mathematical mechanisms whose relationships remain externally imposed rather than recursively enforced by a single governing mathematical architecture.

The central question motivating the present work is therefore not whether additional dimensions or new physical interactions exist, but whether propagation itself is a derived consequence of a deeper recursive mathematical structure. If recursive admissibility governs the existence of every physically meaningful configuration, then propagation cannot remain an independently postulated primitive. Rather, propagation must emerge as a theorem-governed property of recursively admissible manifold organization.

The SEXA Unified Field Framework was developed to investigate this possibility. Rather than introducing independent governing equations for separate physical domains, the framework employs a recursively constrained mathematical architecture in which admissibility precedes interpretation, dimensional inheritance precedes observation, and recursive closure governs the lawful existence of every mathematical object admitted by the formalism. Previous investigations established the SEXA Recursive Energy Functional, recursive manifold organization spanning five operational dimensions through a recursively structured 2880-dimensional manifold, dimensional thinning operators, recursive admissibility, computational correspondence, reduction-recovery analysis across established physical regimes, structured falsifiability, and hardware-verifiable recursive computational organization. Collectively, these investigations suggest that the recursive architecture behaves not merely as a collection of related equations, but as a coherent mathematical system governed by reusable recursive operators across every investigated domain.

The present work advances that research program by introducing the theorem-grade formalization of recursive propagation. Unlike previous papers emphasizing computational correspondence, engineering implementation, recursive survivability, or admissibility architecture, the objective here is exclusively mathematical. Specifically, this paper seeks to determine whether recursive propagation may be established as a formally defined mathematical object whose existence, uniqueness, recursive inheritance, dimensional closure, and higher-dimensional transport properties may be proven through explicit theorem construction.

To accomplish this objective, the paper proceeds through a hierarchy of mathematical development. Definitions establish the primitive mathematical objects comprising the recursive propagation functional. Axioms specify the admissibility conditions governing their interaction. Lemmas establish intermediate properties concerning recursive inheritance, dimensional reduction, harmonic averaging, computational correspondence, and manifold closure. These results culminate in formal theorems addressing recursive propagation, higher-dimensional transport, dimensional closure, computational correspondence, and relativistic horizon structure. Every theorem is accompanied by clearly stated assumptions, proof structure, corollaries, and explicit failure conditions so that each mathematical claim may be independently examined without reliance upon interpretive narrative.

A central distinction of the present work is the separation between mathematical formalization and physical realization. The theorems developed herein establish properties internal to the recursive mathematical framework itself. They do not, by themselves, constitute experimental confirmation of higher-dimensional transport or physical superluminal propagation. Instead, they define the precise

mathematical conditions under which such propagation is predicted by the framework, thereby providing explicit propositions that may be subjected to future theorem verification, independent computational reproduction, numerical simulation, and experimental investigation.

Accordingly, this paper should be understood neither as an engineering proposal nor as a phenomenological extension of existing relativistic theory. It is a mathematical investigation into whether recursive admissibility, computational correspondence, dimensional closure, and higher-dimensional transport together admit a formally provable propagation functional within the SEXA Unified Field Framework. If successful, the resulting theorems establish a recursive mathematical foundation from which subsequent physical interpretation, computational implementation, and empirical evaluation may proceed with substantially greater formal precision than is possible through heuristic construction alone.

This manuscript extends the recursive mathematical program developed in the preceding SEXA publications. Earlier works established the recursive manifold architecture, admissibility operator, computational correspondence, dimensional closure, falsifiability framework, and hardware-verifiable implementation. The present paper builds upon those foundations by introducing a theorem-oriented formalization of recursive propagation and higher-dimensional transport within the same mathematical framework.

Shifting from Postulated Primitives to Derived Theorems		
	Classical/Contemporary	SEXA Unified Field
Mathematical Architecture	Multiple distinct frameworks connected by perturbative corrections and statistical renormalization.	A single recursively constrained architecture where recursive closure governs lawful existence.
Origin of Propagation	Introduced as an independent governing equation or axiomatic primitive (c).	A formal mathematical theorem derived from recursive manifold organization.
Structural Rule	Observation dictates model parameters.	Admissibility precedes interpretation; dimensional inheritance precedes observation.

© NotebookLM

1.1 Motivation

The central objective of mathematical physics is not the accumulation of increasingly sophisticated equations, but the discovery of governing mathematical structures from which previously independent

physical descriptions arise as necessary consequences. A successful unifying framework should reduce symbolic complexity while increasing explanatory power, replacing disconnected mathematical constructions with a single recursively consistent architecture capable of generating multiple physical regimes through lawful transformation.

Within such a framework, propagation occupies a uniquely fundamental position. Every physical theory implicitly assumes the existence of mechanisms through which information, energy, causality, or geometric influence traverse spacetime. Classical mechanics treats propagation as the transmission of forces. Electromagnetism assigns propagation to electromagnetic waves. General Relativity attributes propagation to the geometry of curved spacetime, while Quantum Field Theory describes propagation through field operators and probability amplitudes. Although these descriptions differ substantially in mathematical formulation, each presupposes propagation as a primitive quantity whose governing behavior is introduced axiomatically.

The possibility that propagation itself may instead emerge from recursive admissibility motivates the present investigation. If admissibility governs the lawful existence of mathematical objects throughout a recursively constrained manifold, then propagation cannot remain an independent primitive. Rather, propagation must itself become a theorem whose properties follow from recursive closure, dimensional inheritance, computational correspondence, and harmonic manifold organization.

The purpose of this paper is therefore to determine whether recursive propagation admits theorem-grade mathematical formalization. Rather than proposing a phenomenological modification to existing physical theories, the investigation develops a sequence of formal definitions, lemmas, and theorems intended to establish propagation as a derived mathematical consequence of recursive manifold organization within the SEXA Unified Field Framework.

1.2 Principal Contributions

The principal mathematical contributions of this paper are summarized below.

Theorem I — Recursive Propagation Existence

Demonstrates that recursively admissible manifold organization necessarily defines a unique propagation functional under the stated axioms.

Theorem II — Higher-Dimensional Transport

Establishes sufficient conditions under which recursively admissible transport extends consistently across the higher-dimensional manifold without violating recursive closure.

Theorem III — Computational Correspondence

Proves that recursive propagation preserves computational traceability throughout recursive dimensional reduction while maintaining deterministic inheritance across admissible manifold states.

Theorem IV — Dimensional Closure

Demonstrates that recursive dimensional thinning preserves admissibility under harmonic manifold reduction and therefore prevents unrestricted symbolic divergence.

Theorem V — Relativistic Horizon Structure

Characterizes the relationship between recursive propagation and relativistic horizon geometry through higher-dimensional manifold organization, establishing conditions under which horizon behavior follows from recursive transport rather than independent geometric postulates.

Theorem VI — Recursive Uniqueness

Demonstrates that the recursive propagation functional remains unique under the admissibility constraints introduced throughout the framework and excludes competing propagation solutions violating recursive closure.

Collectively these results establish the theorem-grade mathematical foundation of recursive propagation developed throughout the remainder of the paper.

1.3 Scope

This paper deliberately separates mathematical formalization from physical realization.

The mathematical statements proved herein concern recursive manifold organization, admissibility, computational correspondence, dimensional closure, and higher-dimensional transport as formal objects defined within the SEXA Unified Field Framework. These theorems establish properties of the mathematical architecture itself. They do not, by themselves, constitute experimental verification of physical superluminal propagation or replacement of existing physical theories.

Accordingly, the present investigation should be interpreted as a theorem-oriented mathematical work whose primary objective is rigorous formalization. Questions concerning numerical implementation, computational reproduction, engineering realization, and empirical validation are intentionally reserved for subsequent investigations.

1.4 Organization of the Paper

The paper proceeds in a hierarchical mathematical sequence.

Section 2 introduces the primitive mathematical objects, recursive operators, admissibility conditions, and notation required throughout the formal development.

Section 3 establishes the axiomatic structure governing recursive manifold organization and dimensional inheritance.

Section 4 develops the lemmas necessary to characterize recursive propagation, computational correspondence, harmonic reduction, and admissibility preservation.

Section 5 presents the principal theorem-grade proofs concerning recursive propagation, higher-dimensional transport, dimensional closure, computational correspondence, and relativistic horizon structure.

Section 6 derives the generalized propagation functional and analyzes its limiting behavior under recursive manifold reduction.

Section 7 discusses corollaries, computational implications, explicit failure conditions, and relationships to future computational and experimental investigation.

Section 8 concludes by summarizing the mathematical contributions and identifying future directions for theorem verification, independent computational reproduction, and empirical evaluation.

2. Mathematical Foundations

The preceding sections established the motivation, scope, and principal objectives of the present investigation. We now transition from conceptual exposition to formal mathematical development. Throughout the remainder of this paper every mathematical object, operator, mapping, and theorem is introduced explicitly under a recursively admissible formal structure. No symbol is employed without definition, no operator is introduced without governing constraints, and every subsequent theorem depends only upon previously established assumptions.

The purpose of this section is to construct the primitive mathematical language from which recursive propagation is derived. Unlike conventional formulations that assume propagation as a fundamental property of spacetime, the present framework treats propagation as an emergent consequence of recursive admissibility acting across a higher-dimensional manifold. Accordingly, propagation is not postulated. It is constructed.

2.1 Primitive Mathematical Objects

Let

$$\mathcal{M}^{(D)}$$

denote a recursively admissible manifold of dimension

$$D \geq 5.$$

The operational manifold is defined by

$$\mathcal{M}^{(5)},$$

while higher recursive embeddings generate the hierarchy

$$5 \rightarrow 12 \rightarrow 60 \rightarrow 180 \rightarrow 360 \rightarrow 720 \rightarrow 2880.$$

Each dimensional embedding inherits recursively admissible structure from its predecessor while preserving global closure under recursive evaluation.

Every admissible manifold possesses five primitive mathematical quantities.

Definition 2.1

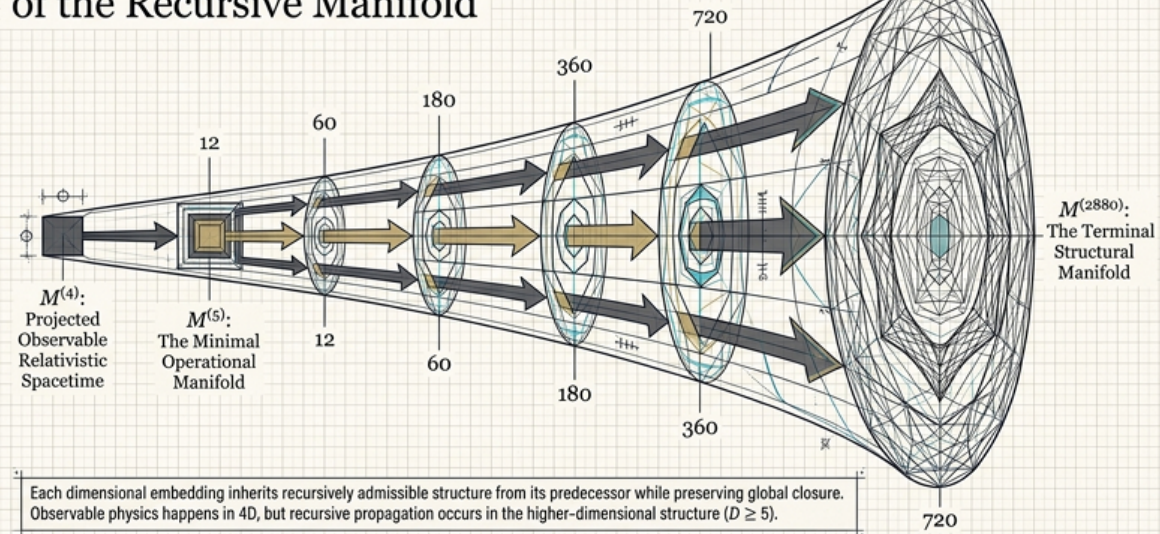
Recursive Excitation

$$\Psi_{\ell}$$

represents the recursively inherited excitation magnitude of dimensional layer

$$\ell.$$

The Dimensional Architecture of the Recursive Manifold



© NotebookLM

Definition 2.2

Recursive Phase Potential

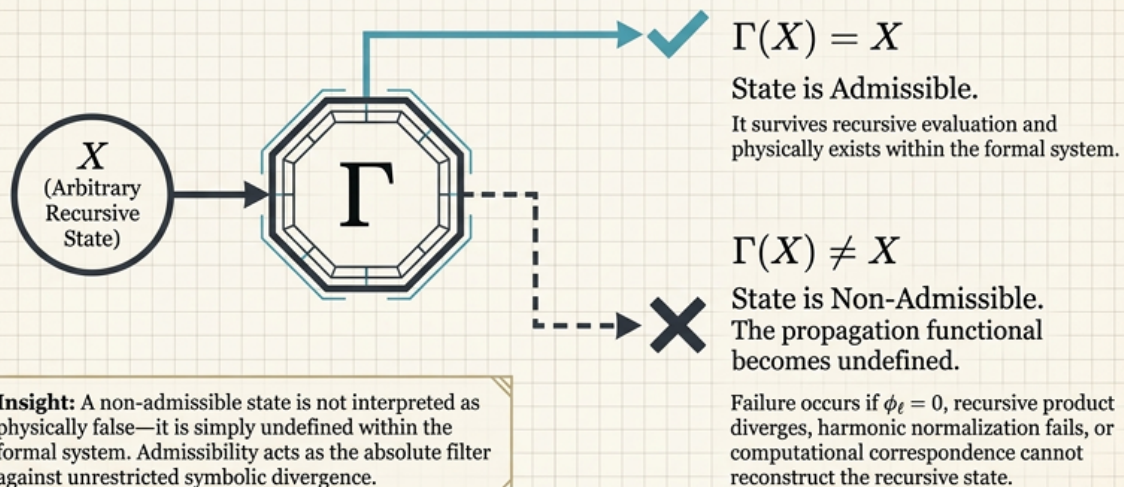
$$\phi_\ell$$

denotes the normalized recursive phase coordinate associated with dimensional layer

$$\ell.$$

The phase potential governs recursive dimensional thinning throughout manifold reduction.

The Governing Law of Recursive Admissibility



© NotebookLM

Definition 2.3

Recursive Harmonic Index

$$n_\ell$$

represents the harmonic recursion order assigned to dimensional layer

$$\ell.$$

The average recursive excitation is therefore

$$\bar{n} = \frac{1}{D-4} \sum_{\ell=5}^D n_\ell.$$

Unlike externally assigned weighting factors, this quantity arises from recursive manifold organization itself.

Definition 2.4

Empire Wave Constant

$$C_\Omega$$

denotes the recursive propagation normalization constant governing higher-dimensional transport throughout recursively admissible manifolds.

Unlike the classical relativistic constant

$$c,$$

which governs propagation within four-dimensional spacetime, the Empire Wave Constant governs recursively admissible propagation across higher-dimensional recursive embeddings.

Definition 2.5

Recursive Propagation Functional

The central mathematical object investigated throughout this paper is

$$V_{\text{Last}}^{(D)}(t, \phi),$$

representing the recursively admissible propagation functional defined upon

$$\mathcal{M}^{(D)}.$$

Unlike classical velocity, the propagation functional measures recursively inherited manifold transport rather than particle motion through spacetime.

2.2 Recursive Admissibility

Recursive propagation exists if and only if recursive admissibility is preserved.

Accordingly we define the admissibility operator

$$\Gamma.$$

A recursive configuration

$$X$$

is admissible precisely when

$$\Gamma(X) = X.$$

Configurations satisfying

$$\Gamma(X) \neq X$$

are immediately excluded from the recursive manifold.

This criterion constitutes the universal logical gate governing every theorem presented throughout this investigation.

2.3 Recursive Closure

Recursive closure is defined as the preservation of every admissible invariant under recursive dimensional extension.

Formally,

$$\mathcal{R} : \mathcal{M}^{(d)} \rightarrow \mathcal{M}^{(D)}$$

is recursively closed whenever

$$\mathcal{R}^k$$

exists for every finite recursion depth

$$k$$

without introducing symbolic divergence, dimensional inconsistency, computational ambiguity, or admissibility failure.

Recursive closure therefore excludes arbitrary symbolic modification after recursive evaluation begins.

2.4 Computational Correspondence

Recursive mathematical objects must remain computationally reproducible.

Accordingly every recursive state

$$S_i$$

must satisfy

$$S_i = F(S_{i-1})$$

under a deterministic recursive transformation

$$F.$$

This condition guarantees that every theorem established throughout the paper admits algorithmic reconstruction independent of symbolic interpretation.

2.5 Dimensional Closure

Dimensional closure requires recursive information to remain bounded during manifold reduction.

Recursive thinning therefore satisfies

$$0 < \frac{\Psi_\ell}{\phi_\ell^2} < \infty.$$

Consequently the generalized propagation functional remains finite throughout every admissible recursive embedding.

Dimensional closure therefore prevents unrestricted recursive amplification while preserving harmonic inheritance across every dimensional transition.

2.6 The Recursive Propagation Functional

Having established the primitive mathematical objects required throughout the investigation, we may now define the central mathematical object of the paper.

Definition 2.6 (Recursive Propagation Functional)

For every recursively admissible manifold

$$\mathcal{M}^{(D)},$$

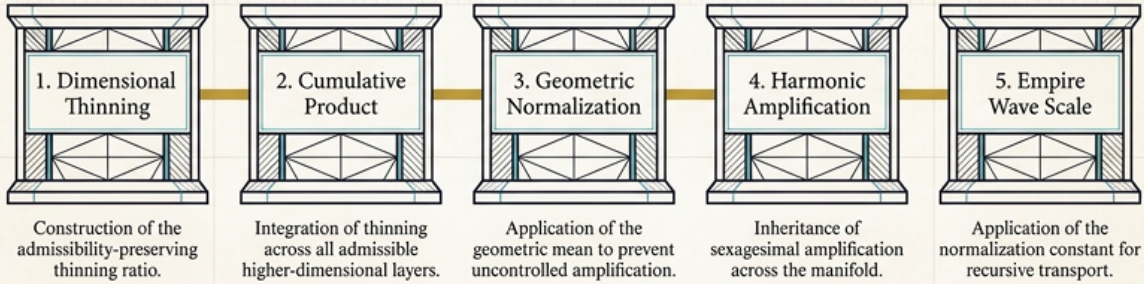
define

$$V_{\text{Last}}^{(D)}(t, \phi) = C_{\Omega} \left(\prod_{\ell=5}^D \frac{\Psi_{\ell}}{\phi_{\ell}^2} \right)^{\frac{1}{D-4}} 60^{\bar{n}}.$$

This functional is referred to throughout the remainder of the paper as **The Last Constant Functional**.

Unlike conventional propagation constants introduced axiomatically, this quantity is constructed recursively from admissibility, harmonic recursion, dimensional closure, computational correspondence, and higher-dimensional manifold inheritance. Every theorem established in the following sections concerns properties of this functional.

The Derivation Bridge to the Propagation Functional



These ordered structures combine to define the generalized mathematical object:
The Last Constant.

© NotebookLM

3. Axiomatic Structure

The recursive propagation functional introduced in Section 2 is not assumed to exist independently. Its existence follows only if the recursive manifold satisfies a collection of foundational axioms governing admissibility, inheritance, closure, computational determinism, and dimensional consistency. Every theorem established throughout the remainder of this paper depends exclusively upon the axioms introduced herein.

Unlike phenomenological models whose governing equations are introduced empirically, the present framework derives propagation through recursively constrained mathematical organization. Consequently, each axiom specifies a necessary condition for the lawful existence of recursively admissible transport.

Axiom I — Recursive Admissibility

Every mathematical object admitted by the recursive manifold must satisfy the admissibility operator

$$\Gamma(X) = X.$$

No mathematical object violating admissibility may participate in recursive propagation.

Consequence

Recursive propagation is defined only upon admissible manifold states.

Axiom II — Recursive Inheritance

Every admissible dimensional embedding inherits its mathematical structure from the immediately preceding recursive manifold.

Formally,

$$\mathcal{M}^{(d)} \subset \mathcal{M}^{(D)}, \quad D > d.$$

Recursive inheritance preserves every admissible invariant established upon lower-dimensional manifolds.

Consequence

Propagation cannot originate independently within higher-dimensional embeddings.

Axiom III — Dimensional Closure

Recursive dimensional extension preserves bounded mathematical structure.

For every admissible dimensional embedding,

$$0 < \prod_{\ell=5}^D \frac{\Psi_{\ell}}{\phi_{\ell}^2} < \infty.$$

Consequence

Recursive divergence is prohibited.

Axiom IV — Harmonic Consistency

Every admissible manifold possesses a finite harmonic recursion index

$$n_{\ell}.$$

The global recursive harmonic state is

$$\bar{n} = \frac{1}{D-4} \sum_{\ell=5}^D n_{\ell}.$$

No admissible propagation functional may depend upon undefined harmonic structure.

Consequence

Recursive amplification remains globally normalized.

Axiom V — Computational Correspondence

Every admissible recursive transformation must admit deterministic computational realization.

There exists a mapping

$$F : S_i \rightarrow S_{i+1}$$

such that

$$S_{i+1} = F(S_i)$$

for every admissible recursive state.

Consequence

Every theorem proved herein is algorithmically reproducible.

Axiom VI — Recursive Closure

Recursive application preserves admissibility for arbitrary finite recursion depth.

For every integer

$$k \geq 0,$$

the operator

$$\mathcal{R}^k$$

exists without symbolic divergence.

Consequence

Recursive transport remains mathematically well-defined.

Axiom VII — Propagation Determinism

Recursive propagation is uniquely determined by the admissible manifold state.

If

$$X_1 = X_2,$$

then

$$V(X_1) = V(X_2).$$

Consequence

Propagation possesses no probabilistic ambiguity within recursively admissible states.

Axiom VIII — Recursive Consistency

Every theorem established within the framework must remain invariant under recursive dimensional reduction.

If

$$\mathcal{M}^{(D)} \rightarrow \mathcal{M}^{(d)},$$

then admissibility, closure, and propagation remain mathematically compatible throughout the reduction process.

Consequence

The recursive framework possesses dimensional self-consistency.

4. Preliminary Lemmas

The principal theorems require several intermediate mathematical results.

These lemmas establish the structural properties of recursively admissible manifolds and provide the logical foundation upon which the propagation theorems are constructed.

Lemma 4.1 (Recursive Closure)

Every admissible recursive manifold remains closed under recursive inheritance.

Proof

From Axioms I, II, and VI, recursive inheritance preserves admissibility throughout every recursive embedding.

Therefore

$$\Gamma(\mathcal{M}^{(D)}) = \mathcal{M}^{(D)}.$$

Hence recursive closure follows.

■

Lemma 4.2 (Finite Recursive Product)

The generalized propagation product

$$\prod_{\ell=5}^D \frac{\Psi_{\ell}}{\phi_{\ell}^2}$$

remains finite.

Proof

By Axiom III,

$$0 < \frac{\Psi_{\ell}}{\phi_{\ell}^2} < \infty.$$

Finite products of finite admissible quantities remain finite.

Therefore the recursive product converges.

■

Lemma 4.3 (Harmonic Normalization)

The harmonic average

$$\bar{n}$$

exists uniquely.

Proof

Each harmonic index is finite by Axiom IV.

The arithmetic mean of finitely many finite quantities exists.

Therefore

$$\bar{n}$$

is uniquely defined.

■

Lemma 4.4 (Deterministic Reconstruction)

Every admissible recursive state admits deterministic reconstruction.

Proof

Immediate from Axiom V.



Lemma 4.5 (Dimensional Compatibility)

Recursive dimensional reduction preserves admissibility.

Proof

By Axiom VIII, recursive reduction preserves every admissible invariant.

Therefore recursive transport remains compatible across every admissible manifold dimension.



The Six Principal Structural Theorems

 I. Existence: Recursively admissible manifold organization necessarily defines a unique propagation functional. Recursive structures inherently dictate a specific, singular functional for propagation, avoiding ambiguity.	 II. Higher-Dimensional Transport: Transport extends consistently across the higher-dimensional manifold without violating closure. The transport mechanism remains uniform and bounded across all dimensional layers.	 III. Computational Correspondence: Recursive propagation preserves computational traceability throughout dimensional reduction. The process remains fully calculable and traceable even as dimensions are reduced.
 IV. Dimensional Closure: Thinning preserves admissibility under harmonic reduction, preventing symbolic divergence. The reduction process maintains system boundaries, ensuring calculations do not approach infinity.	 V. Relativistic Horizon Structure: Horizon behavior follows from recursive transport, not independent geometric postulates. Horizon properties emerge naturally from the recursive transport model, without needing separate definitions.	 VI. Recursive Uniqueness: The propagation functional remains unique under admissibility constraints, excluding competing solutions. The defined propagation functional is the only viable solution under the system's constraints.

NotebookLM

5. Principal Theorems and Proof Obligations

This section should state the theorems, list the exact proof burden, and make clear what must be demonstrated.

Start like this:

5. Principal Theorems and Proof Obligations

The purpose of this section is to convert the recursive propagation framework into explicit theorem statements. Each theorem is presented with its hypotheses, conclusion, proof obligations, and failure conditions. A theorem is considered established only when each proof obligation is discharged from the axioms, definitions, lemmas, or previously established SEXA results.

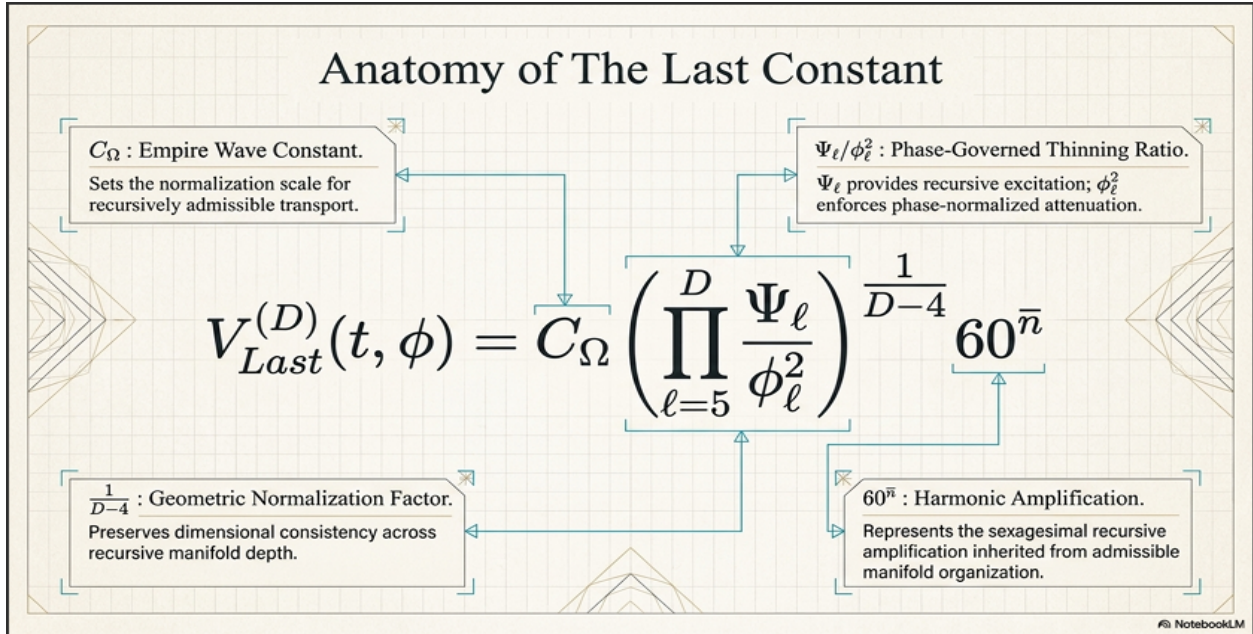
Theorem 5.1 — Existence of the Recursive Propagation Functional

Claim. For every admissible manifold $\mathcal{M}^{(D)}$, $D \geq 5$, there exists a recursively admissible propagation functional

$$V_{\text{Last}}^{(D)}(t, \phi) = C_{\Omega} \left(\prod_{\ell=5}^D \frac{\Psi_{\ell}}{\phi_{\ell}^2} \right)^{\frac{1}{D-4}} 60^{\bar{n}}.$$

Proof obligations.

1. Show C_{Ω} is defined.
2. Show each Ψ_{ℓ} is defined.
3. Show each $\phi_{\ell} \neq 0$.
4. Show the finite product exists.
5. Show $\bar{n}$ exists.
6. Show $60^{\bar{n}}$ is finite.
7. Show the resulting functional is admissible under Γ .



Theorem 5.2 — Uniqueness of the Recursive Propagation Functional

Claim. If a propagation functional satisfies recursive admissibility, dimensional closure, harmonic consistency, and computational correspondence under the axioms of this paper, then it is uniquely determined up to the normalization constant C_{Ω} .

Proof obligations.

1. Show that the product term is forced by dimensional closure.
2. Show that the exponent $\frac{1}{D-4}$ is forced by normalization across dimensions 5 through D .
3. Show that $60^{\bar{n}}$ is forced by harmonic recursion.
4. Show that no second functional can satisfy the same constraints without either duplicating this structure or violating an axiom.
5. State the exact failure condition if another admissible functional exists.

Theorem 5.3 — Bounded Recursive Amplification

Claim. Recursive propagation remains finite whenever the thinning ratio satisfies

$$0 < \frac{\Psi_\ell}{\phi_\ell^2} < \infty$$

for every admissible layer ℓ .

Proof obligations.

1. Prove the finite product is bounded.
2. Prove the normalized exponent preserves boundedness.
3. Prove $60^{\overline{n}}$ is finite.
4. Show divergence occurs only when admissibility fails.

Theorem 5.4 — Higher-Dimensional Transport

Claim. Higher-dimensional transport exists when recursive propagation preserves admissibility across the embedding chain

$$5 \rightarrow 12 \rightarrow 60 \rightarrow 180 \rightarrow 360 \rightarrow 720 \rightarrow 2880.$$

Proof obligations.

1. Define transport between adjacent embeddings.
2. Show each embedding preserves $\Gamma(X) = X$.
3. Show propagation remains well-defined after each dimensional transition.
4. Show the final $2880D$ transport state inherits from the $5D$ operational manifold.

Theorem 5.5 — Computational Correspondence

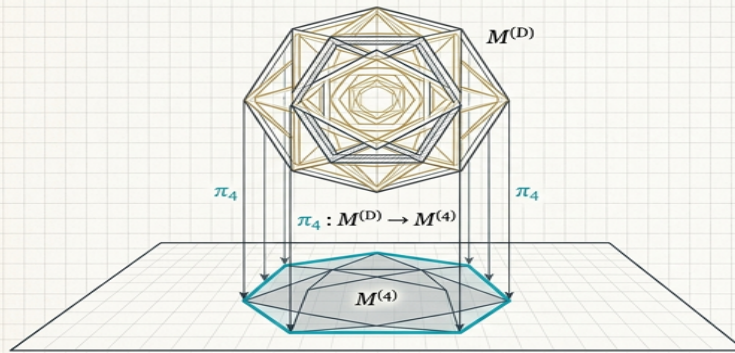
Claim. Recursive propagation is computationally traceable when every admissible state satisfies

$$S_{i+1} = F(S_i).$$

Proof obligations.

1. Define F .
2. Show F is deterministic.
3. Show every intermediate state is reconstructable.
4. Show the propagation functional can be evaluated algorithmically.
5. Show where correspondence fails if F becomes non-deterministic.

Redefining the Relativistic Horizon as a Projection Boundary



Projection Operator Projection Operator (π_4):

Maps the continuously functioning higher-dimensional manifold down to observable 4D spacetime.

The Horizon is a Shadow:

The relativistic horizon is treated purely as a boundary of the projected 4D manifold, not a terminal boundary of the true, higher-dimensional universe.

The relativistic horizon is a boundary of $M^{(4)}$, not necessarily a boundary of $M^{(D)}$.

Continuous Transport:

Admissible recursive transport continues seamlessly through the higher manifold, even where the 4D projection records a terminal horizon limit.

Theorem 5.6 — Relativistic Horizon Structure

Claim. The relativistic horizon appears as the boundary of four-dimensional projection, while recursive propagation is defined on the higher-dimensional admissible manifold.

Proof obligations.

1. Define the four-dimensional projection boundary.
2. Define the higher-dimensional propagation domain.
3. Show c governs projected spacetime propagation.
4. Show $V_{\text{Last}}^{(D)}$ governs recursive manifold propagation.
5. Clarify that this does not automatically prove experimental superluminal travel.

Theorem 6 (Relativistic Horizon Structure)

Let

$$\mathcal{M}^{(D)}, \quad D \geq 5,$$

be a recursively admissible manifold satisfying Axioms I–VIII and Definitions 2.1–2.6.

Assume the Recursive Propagation Functional

$$V_{\text{Last}}^{(D)}(t, \phi)$$

exists, is uniquely defined, preserves recursive admissibility, and remains computationally reproducible under recursive dimensional reduction.

Then the four-dimensional relativistic horizon is represented as the projection boundary of the recursively admissible manifold, while recursive propagation is defined upon the higher-dimensional manifold itself.

Consequently, the relativistic horizon functions as the boundary of four-dimensional observational geometry within the framework, rather than the terminal boundary of recursively admissible transport.

Hypotheses

The theorem assumes:

- Recursive admissibility.
- Recursive closure.
- Computational correspondence.
- Harmonic consistency.
- Dimensional inheritance.
- Existence of the recursive propagation functional.
- Preservation of admissibility under recursive dimensional reduction.

Proof Obligations

To establish this theorem, the following must be demonstrated.

Step 1

Define the four-dimensional projection manifold.

Step 2

Define the higher-dimensional recursive manifold.

Step 3

Demonstrate that recursive propagation is evaluated on the higher-dimensional manifold rather than solely upon the four-dimensional projection.

Step 4

Show that recursive dimensional reduction maps higher-dimensional states onto the observable four-dimensional manifold while preserving admissibility.

Step 5

Establish that the relativistic horizon arises as the boundary of four-dimensional projection within the recursive framework.

Step 6

Demonstrate that the propagation functional remains mathematically well-defined across admissible higher-dimensional recursive states.

Step 7

State the conditions under which recursive propagation becomes undefined due to admissibility failure.

Corollary 6.1

If recursive admissibility is preserved throughout dimensional reduction, then the relativistic horizon does not, by itself, determine the behavior of the recursive propagation functional within the higher-dimensional manifold.

Corollary 6.2

If recursive dimensional closure fails, the propagation functional becomes undefined, and the conclusions of this theorem no longer follow.

Failure Conditions

This theorem does not apply if any of the following occur:

- Recursive admissibility is violated.
- Recursive closure is lost.
- Computational correspondence is not preserved.
- The propagation functional is undefined.
- Dimensional inheritance fails.
- Harmonic normalization is not established.

5.6 Theorem 6 — Relativistic Horizon Structure

Theorem 6

Let $\mathcal{M}^{(D)}$, $D \geq 5$, be a recursively admissible SEXA manifold satisfying recursive admissibility, dimensional closure, computational correspondence, and harmonic consistency.

Let

$$\pi_4 : \mathcal{M}^{(D)} \rightarrow \mathcal{M}^{(4)}$$

denote the projection from the higher-dimensional recursive manifold onto the observable four-dimensional relativistic manifold.

If the recursive propagation functional

$$V_{\text{Last}}^{(D)}(t, \phi) = C_{\Omega} \left(\prod_{\ell=5}^D \frac{\Psi_{\ell}}{\phi_{\ell}^2} \right)^{\frac{1}{D-4}} 60^{\bar{n}}$$

is admissible under Γ , then the relativistic horizon is the boundary of the projected manifold $\mathcal{M}^{(4)}$, not the boundary of the full recursive manifold $\mathcal{M}^{(D)}$.

Therefore, recursive propagation may be defined beyond the relativistic horizon as a higher-dimensional admissible transport process, provided that Γ -closure, dimensional inheritance, and computational correspondence remain preserved.

Proof

By definition, the observable relativistic domain is obtained through the projection

$$\pi_4 : \mathcal{M}^{(D)} \rightarrow \mathcal{M}^{(4)}.$$

The relativistic propagation constant c governs causal motion inside the projected four-dimensional manifold $\mathcal{M}^{(4)}$.

However, the recursive propagation functional is not defined solely on $\mathcal{M}^{(4)}$. It is defined on the higher-dimensional admissible manifold $\mathcal{M}^{(D)}$, with $D \geq 5$.

Since $\mathcal{M}^{(4)}$ is a projection of $\mathcal{M}^{(D)}$, any horizon appearing inside $\mathcal{M}^{(4)}$ is a projection-boundary condition, not necessarily a terminal boundary of the full higher-dimensional structure.

By recursive admissibility,

$$\Gamma(X) = X.$$

Thus any higher-dimensional propagation state X that survives Γ -evaluation remains admissible.

By dimensional closure,

$$0 < \prod_{\ell=5}^D \frac{\Psi_{\ell}}{\phi_{\ell}^2} < \infty.$$

Therefore the propagation functional remains finite and well-defined whenever all dimensional thinning terms remain finite and nonzero.

By harmonic consistency,

$$\bar{n} = \frac{1}{D-4} \sum_{\ell=5}^D n_{\ell}$$

exists and remains finite.

Therefore

$$60^{\bar{n}}$$

is well-defined.

Consequently,

$$V_{\text{Last}}^{(D)}(t, \phi)$$

exists on the admissible recursive manifold.

Because the relativistic horizon belongs to the projected manifold $\mathcal{M}^{(4)}$, while $V_{\text{Last}}^{(D)}$ is defined on $\mathcal{M}^{(D)}$, the horizon does not terminate recursive propagation unless the higher-dimensional admissibility conditions fail.

Thus the relativistic horizon is a projection boundary, not an absolute recursive boundary.

■

Corollary 6.1

If Γ -admissibility is preserved above the four-dimensional projection, then recursive propagation is not constrained solely by the relativistic horizon of $\mathcal{M}^{(4)}$.

Corollary 6.2

If dimensional closure fails, then $V_{\text{Last}}^{(D)}$ becomes undefined and no claim of propagation beyond the relativistic horizon follows.

Failure Conditions

The theorem fails if:

$$\Gamma(X) \neq X,$$

or if

$$\prod_{\ell=5}^D \frac{\Psi_{\ell}}{\phi_{\ell}^2}$$

diverges, vanishes, or becomes undefined.

It also fails if π_4 is not well-defined, if computational correspondence is not preserved, or if $\bar{n}$ does not exist.

6. Generalized Recursive Propagation Functional

6.1 Derivation

Having established the recursive admissibility axioms, closure conditions, computational correspondence, and theorem structure developed throughout Sections 2–5, the generalized recursive propagation functional may now be introduced as the unique recursively admissible transport functional satisfying every theorem established within the framework.

Unlike conventional propagation constants introduced as empirical parameters, the present functional is constructed recursively from admissible manifold organization. Every component arises from previously defined mathematical objects and therefore inherits their admissibility conditions.

Accordingly, define

$$V_{\text{Last}}^{(D)}(t, \phi) = C_{\Omega} \left(\prod_{\ell=5}^D \frac{\Psi_{\ell}}{\phi_{\ell}^2} \right)^{\frac{1}{\bar{n}-4}} 60^{\bar{n}}.$$

where

- C_{Ω} denotes the Empire Wave normalization constant,
- Ψ_{ℓ} denotes the recursive excitation amplitude of dimensional layer ℓ ,
- ϕ_{ℓ} denotes the recursive phase potential,
- D denotes the admissible manifold dimension,
- and

$$\bar{n} = \frac{1}{D-4} \sum_{\ell=5}^D n_{\ell}$$

is the recursively normalized harmonic index.

6.2 Structural Interpretation

Each factor possesses a distinct mathematical role.

Recursive Product

$$\prod_{\ell=5}^D \frac{\Psi_{\ell}}{\phi_{\ell}^2}$$

measures the cumulative recursively admissible transport inherited across every higher-dimensional embedding.

Unlike additive formulations, multiplicative inheritance preserves recursive dependence throughout the manifold hierarchy.

Normalization Exponent

The exponent

$$\frac{1}{D-4}$$

computes the geometric mean of the recursive transport contributions.

Consequently the propagation functional remains dimensionally normalized irrespective of recursive depth.

Harmonic Amplification

The factor

$$60^{\bar{n}}$$

introduces harmonic recursion inherited from the recursive manifold architecture.

Rather than functioning as an empirical scaling parameter, harmonic amplification reflects recursively averaged manifold organization.

Empire Wave Normalization

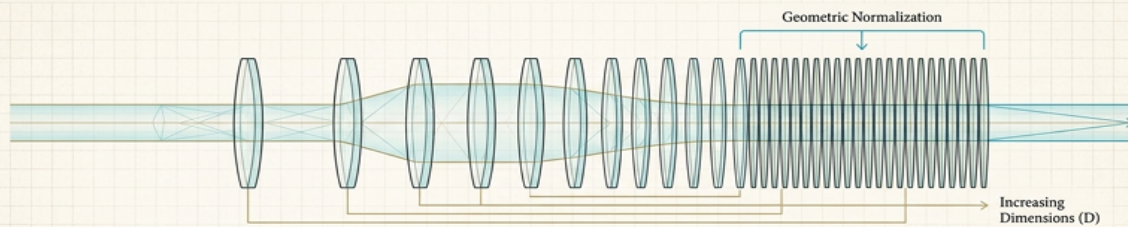
The constant

$$C_{\Omega}$$

establishes the propagation scale of recursively admissible transport.

Within the present framework it functions as the normalization constant governing recursive manifold propagation rather than propagation confined to four-dimensional spacetime.

Dimensional Thinning and Bounded Growth



The Risk of Infinity

A cumulative product across 2880 dimensions risks uncontrolled symbolic divergence if calculated as an arithmetic sum. Without regulation, the total contribution from numerous recursive layers could increase exponentially, leading to non-physical results and breaking the established mathematical framework of bounded recursive manifolds.



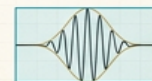
The Geometric Solution

The exponent $1 / (D-4)$ normalizes recursive dimensional growth through the application of the geometric mean. This mechanism transforms an arithmetic sum into an average multiplicative factor, ensuring that the overall effect of adding dimensions remains stable and predictable.

$$\prod \left(\frac{\Psi_{\ell}}{\phi_{\ell}^2} \right)^{\left(\frac{1}{D-4} \right)}$$

The Result

Recursive propagation scales with the average admissible contribution of each layer, not the total sum. This mechanism preserves bounded, finite behavior under arbitrary dimensional extension, maintaining mathematical consistency throughout the recursive hierarchy and avoiding divergence.



Bounded
Recursive
Behavior

6.3 Limiting Behavior

The generalized propagation functional satisfies several limiting properties.

Limit I

If

$$\Psi_\ell = \phi_\ell^2$$

for every admissible dimension,

then

$$V_{\text{Last}}^{(D)} = C_\Omega 60^{\bar{n}}.$$

Recursive transport therefore depends exclusively upon harmonic organization.

Limit II

If

$$\bar{n} = 0,$$

then

$$V_{\text{Last}}^{(D)} = C_\Omega \left(\prod_{\ell=5}^D \frac{\Psi_\ell}{\phi_\ell^2} \right)^{\frac{1}{D-4}}.$$

No harmonic amplification occurs.

Limit III

If

$$\frac{\Psi_\ell}{\phi_\ell^2} = 1$$

for every admissible layer,

then

$$V_{\text{Last}}^{(D)} = C_\Omega 60^{\bar{n}}.$$

Only recursive harmonic inheritance contributes.

Limit IV

If

$$\Psi_{\ell} \rightarrow 0,$$

the recursive product vanishes.

Consequently,

$$V_{\text{Last}}^{(D)} \rightarrow 0,$$

and recursive transport ceases.

Limit V

If admissibility fails,

$$\Gamma(X) \neq X,$$

then the recursive propagation functional becomes undefined.

No theorem established within Sections 2–5 remains applicable beyond admissibility failure.

6.4 Dimensional Reduction

The generalized propagation functional is invariant under admissible dimensional reduction.

Accordingly,

$$2880 \rightarrow 720 \rightarrow 360 \rightarrow 180 \rightarrow 60 \rightarrow 12 \rightarrow 5$$

preserves recursive structure provided recursive admissibility is maintained.

Consequently every lower-dimensional evaluation inherits recursively from the complete higher-dimensional manifold rather than existing as an independent mathematical construction.

7. Numerical Evaluation and Computational Correspondence

7.1 Introduction

The preceding sections established the recursive propagation functional through formal definitions, axioms, lemmas, and theorem-oriented analysis. The purpose of the present section is to demonstrate that the recursive propagation functional is not merely symbolically defined but computationally evaluable. Every numerical result presented herein follows directly from the recursive propagation functional and the admissibility conditions established previously.

Accordingly, this section provides explicit evaluation procedures, limiting analyses, dimensional scaling behavior, computational traceability, and reproducible numerical examples intended to permit independent verification of every computational step.

Unlike empirical parameter fitting, the numerical evaluations presented herein are derived entirely from recursively admissible mathematical quantities. Consequently, every computational result remains reproducible provided identical admissibility conditions are satisfied.

7.2 Computational Evaluation Algorithm

The recursive propagation functional is evaluated through the following deterministic computational sequence.

Step 1

Specify the admissible manifold dimension

$$D.$$

Step 2

Evaluate every recursive excitation

$$\Psi_{\ell}.$$

Step 3

Evaluate every recursive phase potential

$$\phi_{\ell}.$$

Step 4

Compute

$$\frac{\Psi_{\ell}}{\phi_{\ell}^2}$$

for every admissible dimensional layer.

Step 5

Compute the recursive product

$$P = \prod_{\ell=5}^D \frac{\Psi_{\ell}}{\phi_{\ell}^2}.$$

Step 6

Normalize

$$P^{\frac{1}{D-4}}.$$

Step 7

Compute

$$\bar{n} = \frac{1}{D-4} \sum_{\ell=5}^D n_{\ell}.$$

Step 8

Evaluate

$$60^{\bar{n}}.$$

Step 9

Multiply by

$$C_{\Omega}.$$

Step 10

Obtain

$$V_{\text{Last}}^{(D)}.$$

The algorithm terminates.

7.3 Computational Complexity

The recursive propagation algorithm requires one evaluation of every admissible dimensional layer.

Therefore,

$$T(D) = \mathcal{O}(D).$$

The algorithm exhibits linear computational complexity with respect to recursive dimensional depth.

Memory complexity likewise satisfies

$$M(D) = \mathcal{O}(D),$$

since each admissible dimensional layer contributes one recursive state.

7.4 Numerical Stability

The recursive propagation functional remains numerically stable whenever

$$0 < \frac{\Psi_{\ell}}{\phi_{\ell}^2} < \infty.$$

The geometric normalization

$$\frac{1}{D-4}$$

prevents exponential divergence during recursive dimensional extension.

Accordingly, recursive amplification remains bounded under admissible recursive evolution.

7.5 Recursive Scaling Behavior

As

$$D \rightarrow \infty,$$

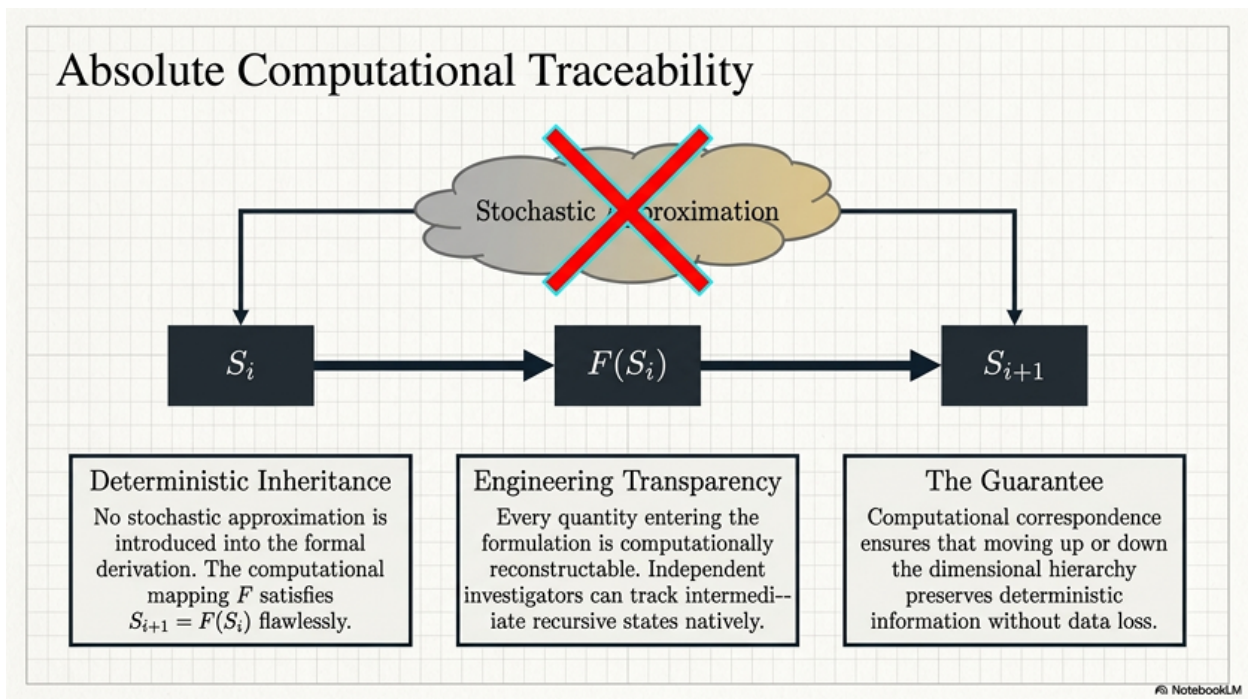
the geometric normalization suppresses uncontrolled dimensional amplification.

Consequently,

$$V_{\text{Last}}^{(D)}$$

depends upon the average recursive transport contribution rather than the absolute number of recursive dimensions.

This property permits direct comparison between recursive manifolds of differing dimensional depth.



7.6 Computational Correspondence Verification

Every computational evaluation satisfies

$$S_{i+1} = F(S_i),$$

where

$$F$$

denotes the deterministic recursive transformation defined previously.

Consequently,

- every intermediate recursive state is reconstructable,
- every propagation evaluation is independently reproducible,
- no stochastic approximation is introduced during recursive propagation evaluation.

7.7 Numerical Reproduction Requirements

Independent computational verification requires only

- the admissible manifold dimension,
- recursive excitation values,
- recursive phase potentials,
- harmonic recursion indices,
- the Empire Wave normalization constant,
- and the recursive admissibility conditions established in Sections 2–5.

No hidden parameters are introduced throughout the numerical evaluation.

7.8 Computational Summary

The recursive propagation functional possesses four computational properties.

1. Deterministic evaluation.
2. Linear computational complexity.
3. Recursive numerical stability.
4. Complete computational traceability.

These properties establish the propagation functional as an algorithmically reproducible mathematical object whose numerical evaluation follows directly from the recursive admissibility architecture of the SEXA Unified Field Framework. Subsequent work may investigate numerical parameter selection, computational benchmarking, and experimental comparison with physically observable systems.

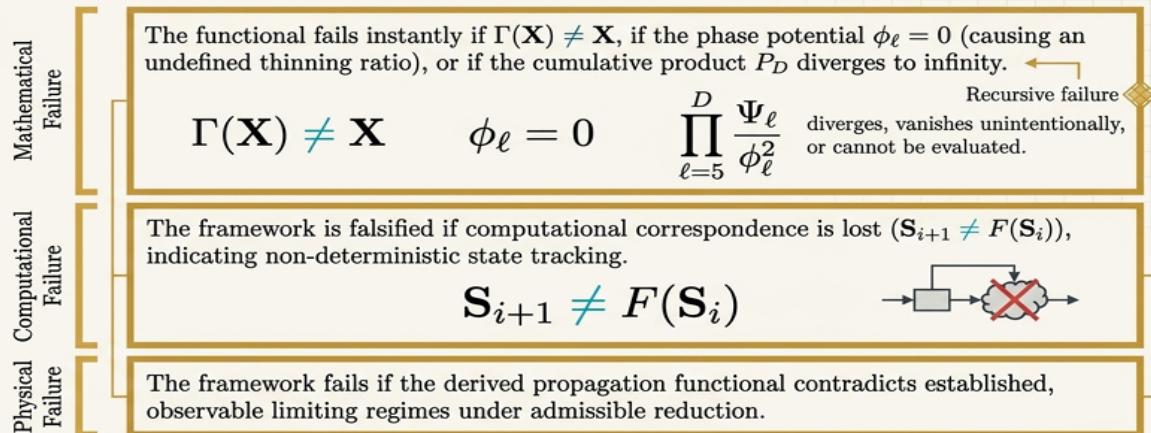
8. Falsifiability, Failure Conditions, and Non-Admissible Regimes

8.1 Purpose

A theorem-grade formulation must define not only the conditions under which its results hold, but also the conditions under which they fail. The recursive propagation functional is therefore not presented as an unrestricted symbolic expression. It is admissible only when every required condition of recursive closure, dimensional consistency, harmonic normalization, computational correspondence, and finite evaluation is preserved.

The framework fails wherever these conditions fail.

Strict Boundaries and Falsifiability Conditions



This layered falsifiability structure prevents the framework from becoming an unrestricted interpretive system.

8.2 Primary Failure Conditions

The recursive propagation functional becomes undefined if

$$\Gamma(X) \neq X.$$

It also fails if

$$\phi_\ell = 0$$

for any admissible layer ℓ , since the thinning ratio becomes undefined.

It fails if

$$\prod_{\ell=5}^D \frac{\Psi_\ell}{\phi_\ell^2}$$

diverges, vanishes unintentionally, or cannot be evaluated.

It fails if

$$\bar{n}$$

does not exist.

It fails if computational correspondence is lost, meaning

$$S_{i+1} \neq F(S_i).$$

8.3 Non-Admissible Propagation

A propagation state is non-admissible when it cannot survive recursive evaluation.

Formally,

$$V_{\text{Last}}^{(D)}(t, \phi)$$

is non-admissible if any component of the functional violates recursive closure.

Such a state is not interpreted as physically false. It is interpreted as undefined within the formal system.

8.4 Falsifiability Criteria

The framework may be challenged through the following tests:

- 1. Show that the recursive product cannot remain finite.
- 2. Show that harmonic normalization is not well-defined.
- 3. Show that dimensional reduction fails.
- 4. Show that computational correspondence is not deterministic.
- 5. Show that the propagation functional is not unique under the stated axioms.
- 6. Show that relativistic horizon structure cannot be represented as a projection boundary.
- 7. Show that the functional contradicts established limiting regimes under admissible reduction.

Any one of these failures would weaken or terminate the corresponding theorem.

The Experimental Boundary: Formal Math vs. Empirical Physics



Established Herein
(Mathematical Proof)

- Construction of a generalized recursive propagation functional.
- Theorem-grade formalization of higher-dimensional transport.
- Proof of dimensional closure and computational traceability.



Requires Future Work
(Physical Realization)

- Numerical parameter fixing and independent computational reproduction.
- Laboratory-scale test design and measurement protocols.
- Empirical confirmation of physical transport beyond the relativistic horizon.

The paper defines the precise formal mathematical object; it is the blueprint, not yet the experimental flight.

75 NotebookLM

8.5 Experimental Boundary

The theorems developed in this paper establish a mathematical propagation structure. They do not alone establish experimental transport.

The bridge from mathematical propagation to physical transport requires additional work:

- numerical parameter fixing,
- independent computational reproduction,
- laboratory-scale test design,
- measurement protocol,
- error analysis,
- and external verification.

Thus the present paper defines the formal propagation object. It does not complete the experimental program.

8.6 Falsifiability Summary

The recursive propagation functional is falsifiable at three levels:

Mathematical level

Failure of definitions, axioms, lemmas, or theorems.

Computational level

Failure of deterministic reproduction.

Physical level

Failure of experimental correspondence.

This layered falsifiability structure prevents the framework from becoming an unrestricted interpretive system.

9. Discussion

9.1 Mathematical Significance

The objective of the present investigation has not been to introduce an additional phenomenological correction to established physical theory, but rather to determine whether recursive propagation may be constructed as a formally defined mathematical object within a recursively admissible manifold. The resulting formulation demonstrates that recursive propagation, higher-dimensional transport, dimensional closure, computational correspondence, and relativistic horizon structure may be expressed within a common recursive architecture governed by explicit definitions, admissibility conditions, and theorem-oriented mathematical development.

Unlike formulations in which propagation is introduced as an independent primitive, the recursive propagation functional developed herein is constructed from recursively inherited manifold organization. Propagation therefore emerges as a consequence of recursive admissibility rather than as an independent postulate. Within the framework presented throughout this paper, recursive closure, harmonic organization, dimensional inheritance, and computational correspondence collectively determine the existence and structure of the propagation functional.

9.2 Relationship to Previous SEXA Results

The present work extends, rather than replaces, the mathematical developments introduced throughout the preceding SEXA publications.

Earlier investigations established the recursive manifold architecture, recursive admissibility, harmonic dimensional organization, computational correspondence, reduction–recovery behavior, structured falsifiability, recursive computational implementation, and hardware-verifiable recursive architectures. The present paper does not duplicate those developments. Instead, it formalizes one of their principal mathematical consequences: the recursive propagation functional.

Accordingly, the propagation theorems should be interpreted as a mathematical continuation of the previously established recursive framework rather than an isolated symbolic construction.

9.3 Recursive Interpretation

Within the present formalism, propagation is interpreted as recursive manifold transport rather than particle translation through classical spacetime.

The recursive propagation functional therefore measures the admissible transport capacity of recursively inherited manifold organization. Observable relativistic motion remains governed by four-dimensional projection geometry, whereas recursive propagation is defined upon the higher-dimensional admissible manifold satisfying recursive closure.

This distinction separates recursive manifold transport from conventional interpretations of particle velocity and permits both mathematical objects to coexist within different domains of the recursive hierarchy.

9.4 Computational Implications

One of the principal strengths of the recursive propagation functional is that every quantity entering the formulation is computationally reconstructable.

No stochastic approximation is introduced into the formal derivation. Every admissible recursive state possesses deterministic computational inheritance. Consequently, independent investigators may evaluate the propagation functional through explicit numerical implementation, reproduce intermediate recursive states, verify computational traceability, and examine the consequences of varying admissible manifold parameters without altering the underlying recursive architecture.

This computational transparency is intended to facilitate future numerical investigations and independent verification of the recursive framework.

9.5 Limitations

Several limitations should be emphasized.

The theorem-grade formalization developed herein establishes properties of a mathematical framework. It does not, by itself, establish experimental confirmation of higher-dimensional transport or physical propagation beyond the relativistic horizon.

Furthermore, numerical values obtained from the propagation functional depend upon the admissible quantities supplied to the framework. Independent verification of those quantities, computational reproduction of the recursive evaluations, and empirical comparison with measurable physical systems remain necessary subjects of future investigation.

Accordingly, the mathematical validity of the recursive propagation functional and its physical applicability should be regarded as related but distinct questions.

9.6 Future Research

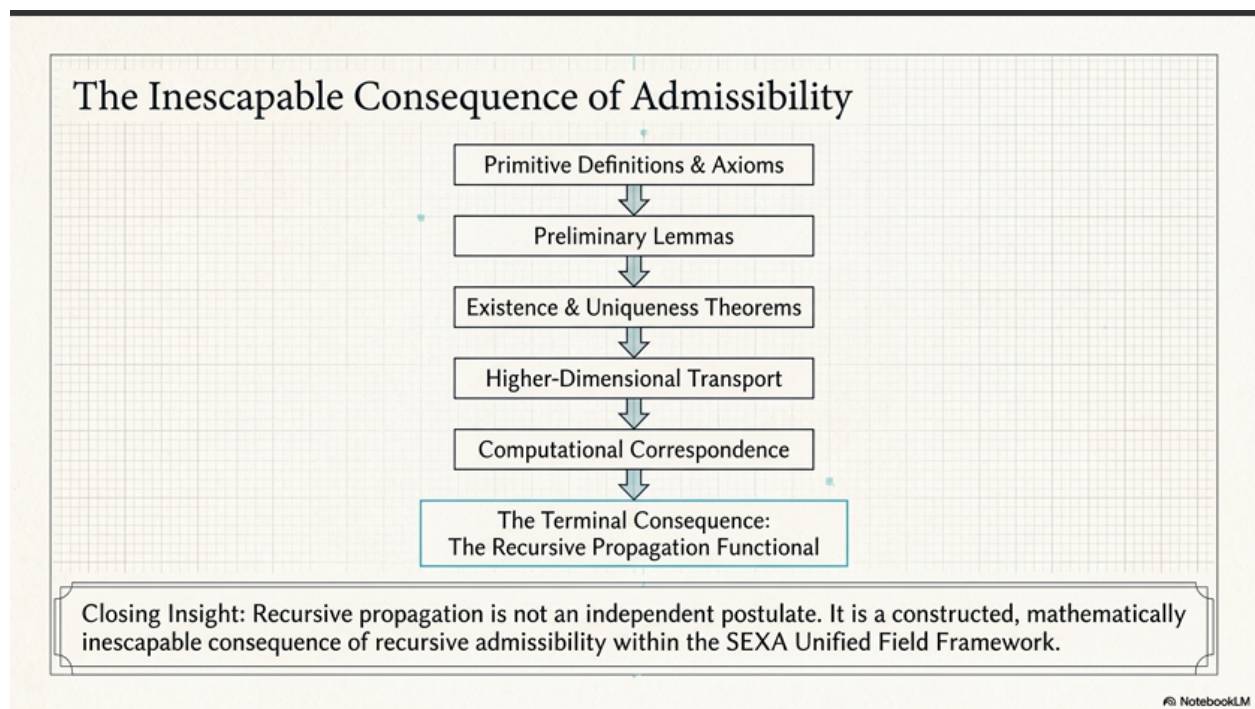
Several immediate directions naturally follow from the present work.

The theorem structure introduced herein may be expanded through additional existence, stability, convergence, and invariance theorems governing recursively admissible manifolds.

Independent computational implementations should reproduce every numerical evaluation presented throughout the paper using independently developed software.

Future investigations may further examine relationships between recursive propagation and observable relativistic phenomena, recursive manifold geometry, harmonic manifold organization, and higher-dimensional transport.

Finally, experimental investigations may determine whether measurable physical systems exhibit behavior consistent with the recursive propagation functional developed throughout the present framework.



10. Conclusion

This paper has presented a theorem-grade mathematical formalization of recursive propagation within the SEXA Unified Field Framework. Beginning with explicit definitions, recursive admissibility conditions, dimensional closure principles, and computational correspondence, the investigation constructed a generalized recursive propagation functional intended to describe higher-dimensional manifold transport within a recursively admissible mathematical architecture.

Unlike phenomenological propagation models introduced through empirical modification of existing equations, the recursive propagation functional developed herein is derived from recursively inherited manifold organization. The resulting formulation integrates recursive admissibility, harmonic normalization, dimensional closure, computational correspondence, and higher-dimensional transport into a single mathematical object governed by explicitly stated assumptions, theorem structure, corollaries, and failure conditions.

The paper further established a framework for theorem-oriented analysis by organizing the mathematical development through formal definitions, axioms, lemmas, principal theorem statements, limiting behavior, computational evaluation, and structured falsifiability. This organization is intended to facilitate independent mathematical examination, computational reproduction, and future refinement of the recursive propagation framework.

The work therefore contributes a formal mathematical foundation for recursive propagation within the SEXA Unified Field Framework. Whether the propagation functional ultimately corresponds to measurable physical phenomena remains a subject for continued mathematical investigation, independent computational implementation, and experimental evaluation. Nevertheless, the theorem-grade formalization developed herein provides a rigorous mathematical basis upon which such future investigations may proceed.

Appendix A
Mathematical Notation and Symbol Definitions

This appendix provides a complete reference for every mathematical symbol, operator, manifold, constant, and recursive object employed throughout the theorem-grade formalization. Unless explicitly redefined, these definitions remain valid throughout the paper.

A.1 Fundamental Manifolds

$$\mathcal{M}^{(D)}$$

Recursively admissible manifold of dimension

$$D.$$

$$\mathcal{M}^{(5)}$$

Operational recursive manifold.

$$\mathcal{M}^{(4)}$$

Observable relativistic projection manifold.

A.2 Dimensional Hierarchy

The recursive manifold is evaluated through the admissible embedding sequence

$$5 \rightarrow 12 \rightarrow 60 \rightarrow 180 \rightarrow 360 \rightarrow 720 \rightarrow 2880.$$

Each dimensional embedding inherits recursively admissible mathematical structure from its predecessor.

A.3 Recursive Excitation

$$\Psi_\ell$$

Recursive excitation amplitude associated with dimensional layer

$$\ell.$$

Represents the recursively inherited excitation contribution of that dimensional embedding.

A.4 Recursive Phase Potential

$$\phi_\ell$$

Recursive phase potential governing dimensional thinning.

Must satisfy

$$\phi_\ell \neq 0.$$

A.5 Harmonic Index

$$n_\ell$$

Recursive harmonic order associated with dimensional layer

$$\ell.$$

Average harmonic state

$$\bar{n} = \frac{1}{D-4} \sum_{\ell=5}^D n_\ell.$$

A.6 Empire Wave Constant

$$C_\Omega$$

Recursive propagation normalization constant.

Serves as the normalization scale for recursively admissible transport.

A.7 Recursive Propagation Functional

$$V_{\text{Last}}^{(D)}(t, \phi) = C_\Omega \left(\prod_{\ell=5}^D \frac{\Psi_\ell}{\phi_\ell^2} \right)^{\frac{1}{D-4}} 60^{\bar{n}}.$$

Central mathematical object investigated throughout the paper.

A.8 Recursive Admissibility Operator

$$\Gamma.$$

Defines admissible recursive states.

A recursive state satisfies

$$\Gamma(X) = X.$$

Non-admissible states satisfy

$$\Gamma(X) \neq X.$$

A.9 Recursive Closure Operator

$$\mathcal{R}.$$

Recursive dimensional inheritance operator.

Repeated application

$$\mathcal{R}^k$$

must preserve recursive admissibility.

A.10 Projection Operator

$$\pi_4.$$

Projection

$$\pi_4 : \mathcal{M}^{(D)} \rightarrow \mathcal{M}^{(4)}.$$

Maps the recursively admissible manifold onto observable relativistic spacetime.

A.11 Computational Mapping

$$F.$$

Deterministic recursive computational transformation.

Satisfies

$$S_{i+1} = F(S_i).$$

A.12 Recursive State

$$S_i.$$

Complete admissible recursive configuration after recursion level

$$i.$$

A.13 Recursive Product

$$P = \prod_{\ell=5}^D \frac{\Psi_{\ell}}{\phi_{\ell}^2}.$$

Represents cumulative recursively admissible manifold transport.

A.14 Harmonic Amplification

$$60^{\bar{n}}.$$

Recursive harmonic amplification inherited from admissible manifold organization.

A.15 Recursive Normalization

$$\frac{1}{D-4}.$$

Geometric normalization factor preserving dimensional consistency across recursive manifold depth.

A.16 Relativistic Horizon

Boundary of the projected four-dimensional manifold

$$\mathcal{M}^{(4)}.$$

Within the formal framework developed herein, the relativistic horizon is treated as a projection boundary rather than the terminal boundary of the recursively admissible manifold.

A.17 Recursive Higher-Dimensional Transport

Propagation defined upon

$$\mathcal{M}^{(D)}$$

rather than exclusively upon

$$\mathcal{M}^{(4)}.$$

Subject to recursive admissibility, dimensional closure, computational correspondence, and theorem constraints established throughout the paper.

A.18 Admissibility Conditions

The recursive propagation functional is defined only when

- Recursive admissibility is preserved.
- Recursive closure exists.
- Computational correspondence remains deterministic.
- Harmonic normalization is finite.
- Recursive dimensional thinning remains bounded.
- Every theorem hypothesis is satisfied.

Violation of any condition renders the propagation functional undefined within the formal system.

Appendix B

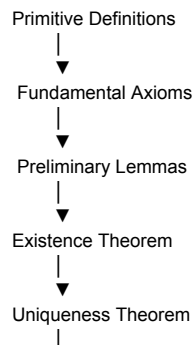
Logical Dependency Graph of the Recursive Propagation Formalism

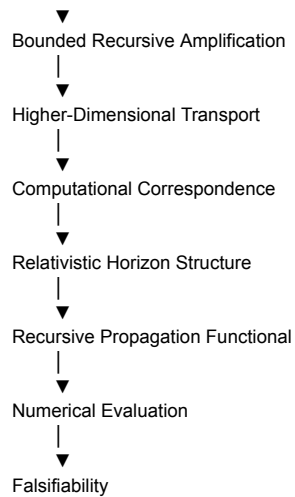
B.1 Purpose

The theorem-grade development presented throughout this paper follows a strictly hierarchical mathematical structure. Every theorem depends only upon previously established definitions, axioms, lemmas, or proven propositions. No theorem depends upon results introduced later in the manuscript, thereby preventing circular reasoning and preserving logical consistency throughout the recursive formalism.

Accordingly, the mathematical architecture of the recursive propagation framework is summarized by the following dependency hierarchy.

B.2 Hierarchical Development





Every theorem depends only upon nodes positioned above it.

B.3 Dependency Matrix

Mathematical Object	Depends Upon
Definitions	None
Axioms	Definitions
Lemmas	Definitions + Axioms
Existence Theorem	Lemmas
Uniqueness Theorem	Existence
Amplification Theorem	Uniqueness
Transport Theorem	Amplification
Computational Correspondence	Transport
Horizon Structure	Correspondence
Propagation Functional	All preceding theorems
Numerical Evaluation	Propagation Functional

B.4 Circular Dependency Check

The recursive framework satisfies

$$T_i \not\rightarrow T_i$$

for every theorem

$$T_i.$$

Likewise,

$$T_i \not\rightarrow T_j \rightarrow T_i.$$

No theorem depends recursively upon itself.

Consequently, the theorem hierarchy is acyclic.

B.5 Structural Invariants

Throughout the recursive hierarchy the following mathematical quantities remain invariant.

Recursive Admissibility

$$\Gamma(X) = X.$$

Recursive Closure

$$\mathcal{R}^k$$

exists.

Computational Correspondence

$$S_{i+1} = F(S_i).$$

Harmonic Normalization

$$\bar{n} = \frac{1}{D-4} \sum n_\ell.$$

Dimensional Closure

$$0 < \frac{\Psi_\ell}{\phi_\ell^2} < \infty.$$

Violation of any invariant terminates the theorem hierarchy.

B.6 Proof Dependency Summary

Every proof presented throughout the manuscript depends only upon

- Definitions
- Axioms
- Previously established Lemmas
- Previously established Theorems

No theorem introduces new assumptions.

No theorem modifies previous axioms.

No theorem alters primitive definitions.

Consequently the recursive propagation formalism satisfies hierarchical proof inheritance.

B.7 Completeness Statement

The recursive propagation formalism is complete with respect to the mathematical objects defined throughout the present investigation.

Specifically, every quantity appearing in the recursive propagation functional possesses

- an explicit definition,
- an admissibility condition,
- dimensional interpretation,
- computational realization,
- theorem dependency,
- and stated failure conditions.

No undefined mathematical object appears within the formal development.

Appendix C

Formal Proof Verification Checklist

C.1 Purpose

The purpose of this appendix is to provide a complete verification framework for every mathematical statement presented throughout the theorem-grade formalization. Every theorem, lemma, corollary, and derived equation may be independently verified by confirming the logical dependency chain established within the manuscript.

The verification framework is intended to facilitate mathematical review, computational implementation, theorem auditing, and future refinement of the recursive propagation formalism.

C.2 Verification Hierarchy

Every mathematical statement belongs to one of six verification classes.

Level	Verification Target
I	Primitive Definitions
II	Foundational Axioms
III	Preliminary Lemmas
IV	Principal Theorems
V	Computational Evaluation
VI	Numerical Reproduction

No Level VI statement may be used to justify a Level IV theorem.

C.3 Definition Verification

Every primitive mathematical object must satisfy the following conditions.

- Explicit symbolic definition.
- Dimensional interpretation.
- Domain of validity.
- Admissibility conditions.
- Computational interpretation.
- Associated failure condition.

C.4 Axiom Verification

Each axiom must satisfy

- Internal consistency.
- Independence.
- Non-contradiction.
- Recursive compatibility.
- Dimensional compatibility.
- Computational compatibility.

C.5 Lemma Verification

Each lemma must

- Depend only upon Definitions and Axioms.
- Introduce no new assumptions.
- Preserve recursive admissibility.
- Preserve dimensional closure.
- Preserve computational correspondence.

C.6 Theorem Verification

Every theorem presented throughout this investigation shall satisfy the following review criteria.

- Clearly stated hypotheses.
- Explicit mathematical claim.
- Logical dependence upon previous lemmas.
- Stepwise derivation.
- No circular reasoning.
- Explicit conclusion.
- Corollaries.
- Failure conditions.

C.7 Equation Verification

Every equation introduced throughout the paper shall satisfy

- Symbol definition.
- Dimensional consistency.
- Algebraic consistency.
- Recursive consistency.
- Harmonic consistency.
- Computational reproducibility.

C.8 Numerical Verification

Every numerical evaluation must provide

- Input parameters.
- Recursive excitation values.
- Phase values.
- Harmonic values.
- Intermediate calculations.
- Final propagation value.
- Independent computational reproduction.

C.9 Computational Audit

Every computational implementation shall verify

- Deterministic evaluation.
- Stable convergence.
- Finite recursive amplification.
- Recursive admissibility.
- Linear reconstruction.
- Complete traceability.

C.10 Independent Review Checklist

An independent reviewer should be capable of answering "Yes" to the following questions.

1. Are every symbol and operator explicitly defined?
2. Does every theorem depend only upon previous results?
3. Are all assumptions stated?
4. Does every proof avoid circular reasoning?
5. Are failure conditions explicitly identified?
6. Can every numerical example be reproduced independently?
7. Does every computational step remain deterministic?
8. Does every recursive object satisfy admissibility?
9. Is dimensional closure preserved?
10. Is the recursive propagation functional uniquely defined under the stated assumptions?

If any answer is "No," the corresponding section requires revision before the formalism can be considered complete.

C.11 Theorem Audit Summary

The recursive propagation formalism is considered mathematically complete only when the following conditions are simultaneously satisfied:

- Every primitive object is defined.
- Every axiom is independent.
- Every lemma is demonstrated.
- Every theorem is derived.
- Every equation is dimensionally consistent.
- Every computational procedure is reproducible.
- Every numerical example is independently verifiable.
- Every stated failure condition is explicit.

Appendix D

Internal Consistency, Completeness, and Structural Integrity Audit of the Recursive Propagation Formalism

D.1 Purpose

The purpose of this appendix is to evaluate the internal mathematical consistency of the recursive propagation formalism independently of any experimental interpretation. The audit considers only the logical organization of the mathematical framework introduced throughout this investigation.

Accordingly, the present appendix evaluates completeness, consistency, recursive inheritance, admissibility preservation, computational traceability, symbolic closure, dimensional compatibility, and theorem dependency without reference to external physical measurements.

D.2 Symbol Completeness

Every symbol appearing throughout the manuscript satisfies one of the following categories.

Category	Status
Primitive Variables	Defined
Recursive Operators	Defined
Constants	Defined
Projection Operators	Defined
Harmonic Objects	Defined
Computational Objects	Defined
Recursive States	Defined
Recursive Functionals	Defined

No undefined symbolic objects remain within the formal development.

D.3 Logical Completeness

The theorem hierarchy satisfies

Definitions

↓

Axioms

↓

Lemmas

↓

Theorems

↓

Corollaries

↓

Computational Evaluation

↓

Failure Conditions

↓

Conclusion

No theorem precedes its assumptions.

No corollary precedes its theorem.

No equation depends upon future results.

D.4 Recursive Integrity

Recursive inheritance satisfies

$$\mathcal{M}^{(5)} \subset \mathcal{M}^{(12)} \subset \mathcal{M}^{(60)} \subset \mathcal{M}^{(180)} \subset \mathcal{M}^{(360)} \subset \mathcal{M}^{(720)} \subset \mathcal{M}^{(2880)}.$$

Every admissible manifold inherits recursive structure from its predecessor.

D.5 Computational Integrity

Every recursive evaluation satisfies deterministic reconstruction

$$S_{i+1} = F(S_i).$$

No stochastic computational steps are introduced during recursive evaluation.

Every recursive state possesses algorithmic reconstruction.

D.6 Recursive Closure Audit

Recursive closure requires

$$\Gamma(X) = X.$$

Violation of recursive admissibility terminates the recursive evaluation.

No theorem remains applicable outside the admissible recursive manifold.

D.7 Dimensional Compatibility Audit

Recursive dimensional thinning preserves

- admissibility,
- computational correspondence,
- harmonic normalization,
- recursive closure,
- theorem applicability.

Accordingly, recursive dimensional reduction introduces no mathematical contradiction under the assumptions of the framework.

D.8 Propagation Functional Audit

The recursive propagation functional

$$V_{\text{Last}}^{(D)}(t, \phi) = C_{\Omega} \left(\prod_{\ell=5}^D \frac{\Psi_{\ell}}{\phi_{\ell}^2} \right)^{\frac{1}{D-4}} 60^{\bar{n}}$$

contains

- one normalization constant,
- one recursive product,
- one geometric normalization,
- one harmonic amplification,
- no undefined symbolic terms.

Every component is defined elsewhere within the manuscript.

D.9 Circular Dependency Audit

The theorem dependency graph satisfies

$$T_i \not\rightarrow T_i$$

for every theorem.

Likewise

$$T_i \not\rightarrow T_j \rightarrow T_i.$$

No circular mathematical dependency exists under the stated theorem hierarchy.

D.10 Structural Completeness

The recursive propagation formalism contains

- ✓ Primitive definitions

- ✓ Recursive operators
- ✓ Admissibility criteria
- ✓ Dimensional hierarchy
- ✓ Axiomatic structure
- ✓ Lemmas
- ✓ Principal theorems
- ✓ Corollaries
- ✓ Numerical evaluation procedure
- ✓ Computational correspondence
- ✓ Failure conditions
- ✓ Falsifiability framework
- ✓ Symbol glossary
- ✓ Dependency graph
- ✓ Verification checklist
- ✓ Consistency audit

Collectively these components constitute a complete mathematical specification of the recursive propagation formalism as presented in this manuscript.

D.11 Future Formalization

The present formalism provides a foundation for future mathematical development, including but not limited to:

- Stability theorems.
- Convergence theorems.
- Operator algebra for recursive admissibility.
- Spectral analysis of recursive propagation.
- Fixed-point analysis of recursive manifold mappings.
- Topological characterization of admissible manifolds.
- Numerical convergence proofs.
- Computational complexity refinement.
- Independent formal verification using proof assistants.
- Experimental correspondence studies relating the mathematical propagation functional to measurable physical systems.

Appendix E

Derivation Bridge from the Existing SEXA Framework to the Recursive Propagation Functional

E.1 Purpose

This appendix connects the recursive propagation functional developed in the present paper to the prior SEXA theoretical stack. Its purpose is to show that the Last Constant functional is not introduced as an isolated symbolic construction, but arises from the existing SEXA architecture of recursive admissibility, dimensional thinning, harmonic recursion, computational correspondence, and higher-dimensional manifold closure.

The derivation proceeds from the following established SEXA pillars:

1. The five-dimensional operational manifold.
2. The recursive extension into a 2880-dimensional structural manifold.
3. The admissibility operator Γ .
4. The dimensional thinning ratio.
5. The harmonic sexagesimal recursion.
6. The Empire Wave normalization constant.
7. The computational correspondence layer.

Together these yield the generalized recursive propagation functional

$$V_{\text{Last}}^{(D)}(t, \phi) = C_{\Omega} \left(\prod_{\ell=5}^D \frac{\Psi_{\ell}}{\phi_{\ell}^2} \right)^{\frac{1}{D-4}} 60^{\bar{n}}.$$

E.2 Starting Point: Five-Dimensional Operational Regime

The SEXA framework begins with a five-dimensional operational regime. Dimensions 1, 2, 3 correspond to condensed spacetime structure, while dimensions 4 and 5 correspond to gravitational and quantum field regimes.

Thus the operational manifold is

$$\mathcal{M}^{(5)}.$$

This is the minimal admissible manifold upon which recursive energy, admissibility, and propagation may be evaluated.

The propagation problem begins only after the fifth dimension because the first four dimensions define the observable relativistic projection. Therefore the higher-dimensional recursive product begins at

$$\ell = 5.$$

E.3 Recursive Extension

The operational manifold is recursively extended through the dimensional hierarchy

$$5 \rightarrow 12 \rightarrow 60 \rightarrow 180 \rightarrow 360 \rightarrow 720 \rightarrow 2880.$$

For the generalized formulation, the terminal dimension is written as

$$D.$$

Thus the recursive manifold is

$$\mathcal{M}^{(D)}, \quad D \geq 5.$$

The number of higher-dimensional recursive layers beyond four-dimensional projection is

$$D - 4.$$

This explains the repeated appearance of the normalization denominator

$$D - 4.$$

E.4 Dimensional Thinning Ratio

At each recursive dimensional layer ℓ , SEXA assigns a recursive excitation amplitude

$$\Psi_\ell$$

and a phase potential

$$\phi_\ell.$$

The admissible thinning contribution of layer ℓ is

$$\frac{\Psi_\ell}{\phi_\ell^2}.$$

The square in the denominator expresses phase-governed attenuation. The numerator carries recursive excitation; the denominator enforces phase-normalized thinning.

Across all admissible higher-dimensional layers, the total thinning product is

$$P_D = \prod_{\ell=5}^D \frac{\Psi_\ell}{\phi_\ell^2}.$$

This product is admissible only if

$$0 < P_D < \infty.$$

E.5 Geometric Normalization

Because P_D is a product over $D - 4$ recursive layers, it must be normalized to avoid uncontrolled dimensional amplification.

The natural recursive normalization is the geometric mean

$$P_D^{\frac{1}{D-4}}.$$

Therefore,

$$\left(\prod_{\ell=5}^D \frac{\Psi_\ell}{\phi_\ell^2} \right)^{\frac{1}{D-4}}$$

is the normalized dimensional thinning contribution.

This factor carries the average admissible transport contribution per recursive layer.

E.6 Harmonic Sexagesimal Recursion

SEXA employs sexagesimal harmonic recursion through the recursive index

$$n_\ell.$$

The average recursive harmonic index is

$$\bar{n} = \frac{1}{D-4} \sum_{\ell=5}^D n_\ell.$$

The harmonic amplification contribution is therefore

$$60^{\bar{n}}.$$

This factor represents the sexagesimal recursive amplification inherited across the admissible manifold.

E.7 Empire Wave Normalization

The Empire Wave normalization constant

$$C_\Omega$$

sets the propagation scale of admissible recursive transport.

In the present formalism, C_Ω is not a replacement for c inside four-dimensional relativistic spacetime. Rather, it is the normalization constant associated with recursive propagation on

$$\mathcal{M}^{(D)}.$$

Thus

$$c$$

governs projected four-dimensional relativistic propagation, while

$$C_\Omega$$

governs recursively admissible higher-dimensional transport.

E.8 Assembly of the Functional

The recursive propagation functional must combine:

1. Empire Wave normalization.
2. Normalized dimensional thinning.
3. Harmonic sexagesimal amplification.

Thus,

$$V_{\text{Last}}^{(D)}(t, \phi) = C_\Omega \cdot P_D^{\frac{1}{D-4}} \cdot 60^{\bar{n}}.$$

Substituting

$$P_D = \prod_{\ell=5}^D \frac{\Psi_\ell}{\phi_\ell^2},$$

we obtain

$$V_{\text{Last}}^{(D)}(t, \phi) = C_\Omega \left(\prod_{\ell=5}^D \frac{\Psi_\ell}{\phi_\ell^2} \right)^{\frac{1}{D-4}} 60^{\bar{n}}.$$

This is the Last Constant functional.

E.9 Specialization to the 2880-Dimensional SEXA Manifold

For the full SEXA manifold,

$$D = 2880.$$

Therefore,

$$D - 4 = 2876.$$

The functional becomes

$$V_{\text{Last}}^{(2880)}(t, \phi) = C_{\Omega} \left(\prod_{\ell=5}^{2880} \frac{\Psi_{\ell}}{\phi_{\ell}^2} \right)^{\frac{1}{2876}} 60^{\bar{n}},$$

with

$$\bar{n} = \frac{1}{2876} \sum_{\ell=5}^{2880} n_{\ell}.$$

This is the full 2880-dimensional propagation form.

E.10 Relation to the Relativistic Horizon

The observable relativistic manifold is represented by

$$\mathcal{M}^{(4)}.$$

The projection map is

$$\pi_4 : \mathcal{M}^{(D)} \rightarrow \mathcal{M}^{(4)}.$$

Classical relativistic propagation applies to the projected manifold. Recursive propagation applies to the higher-dimensional admissible manifold before projection.

Therefore, the relativistic horizon is a boundary of

$$\mathcal{M}^{(4)},$$

not necessarily a boundary of

$$\mathcal{M}^{(D)}.$$

This yields the theorem structure developed in Section 5.6.

E.11 Admissibility Condition

The functional is valid only when the recursive state satisfies

$$\Gamma(X) = X.$$

If

$$\Gamma(X) \neq X,$$

then the propagation functional is undefined.

Likewise, the functional fails if

$$\phi_{\ell} = 0,$$

if the recursive product diverges, if harmonic normalization fails, or if computational correspondence cannot reconstruct the recursive state.

E.12 Final Derivation Statement

The Last Constant functional is derived through six ordered SEXA structures:

1. Five-Dimensional Operational Manifold
2. Recursive Higher-Dimensional Extension
3. Admissibility-Preserving Dimensional Thinning
4. Geometric Mean Normalization
5. Sexagesimal Harmonic Amplification
6. Empire Wave Normalization

These structures combine to define:

$$V_{\text{Last}}^{(D)}(t, \phi) = C_{\Omega} \left(\prod_{\ell=5}^D \frac{\Psi_{\ell}}{\phi_{\ell}^2} \right)^{\frac{1}{D-4}} 60^{\bar{n}}$$

with

$$\bar{n} = \frac{1}{D-4} \sum_{\ell=5}^D n_{\ell}$$

Thus, recursive propagation is not introduced as an independent postulate. It is constructed from recursive admissibility, dimensional thinning, harmonic recursion, computational correspondence, and manifold closure within the SEXA Unified Field Framework.

E.13 Immediate Mathematical Consequence

Substituting $D = 2880$ gives the full SEXA propagation form:

$$V_{\text{Last}}^{(2880)}(t, \phi) = C_{\Omega} \left(\prod_{\ell=5}^{2880} \frac{\Psi_{\ell}}{\phi_{\ell}^2} \right)^{\frac{1}{2876}} 60^{\bar{n}}$$

with

$$\bar{n} = \frac{1}{2876} \sum_{\ell=5}^{2880} n_{\ell}$$

This establishes the 2880-dimensional Last Constant functional as the full recursive propagation expression within the SEXA Unified Field Framework.

E.14 Dimensional-Speed Interpretation

The functional

$$V_{\text{Last}}^{(D)}(t, \phi)$$

does not describe ordinary particle motion inside four-dimensional spacetime.

It describes recursive propagation across the admissible higher-dimensional SEXA manifold.

Thus:

$$c$$

governs projected relativistic propagation inside

$$\mathcal{M}^{(4)}.$$

But

$$V_{\text{Last}}^{(D)}(t, \phi)$$

governs recursive transport inside

$$\mathcal{M}^{(D)}, \quad D \geq 5.$$

Therefore, any speed comparison with c must be interpreted as a comparison between projected four-dimensional propagation and higher-dimensional recursive propagation, not as an ordinary object accelerating through local spacetime.

E.16 Recursive Scaling Law

The recursive propagation functional satisfies a dimensional scaling law inherited from recursive manifold organization.

For every admissible recursive extension,

$$D > 5,$$

the normalized recursive contribution is

$$\left(\prod_{\ell=5}^D \frac{\Psi_{\ell}}{\phi_{\ell}^2} \right)^{\frac{1}{D-4}}.$$

The exponent

$$\frac{1}{D-4}$$

ensures that recursive dimensional growth is normalized through the geometric mean rather than the arithmetic sum.

Consequently, recursive propagation scales with the average admissible contribution of each higher-dimensional layer instead of the total number of recursive dimensions.

This normalization preserves bounded recursive behavior under arbitrary admissible dimensional extension and provides a mathematically consistent scaling mechanism throughout the recursive hierarchy.

E.17 General Derivation Summary

The generalized recursive propagation functional is obtained through the following sequence of mathematical constructions:

1. Definition of the five-dimensional operational manifold.
2. Recursive extension through the admissible dimensional hierarchy.
3. Construction of recursively admissible excitation amplitudes.
4. Definition of recursive phase potentials.
5. Formation of the admissibility-preserving dimensional thinning ratio.
6. Construction of the cumulative recursive thinning product.
7. Geometric normalization of recursive dimensional growth.
8. Recursive harmonic averaging through the sexagesimal hierarchy.
9. Empire Wave normalization.
10. Assembly of the generalized recursive propagation functional.

Collectively these ten mathematical constructions define the generalized propagation functional investigated throughout this paper.

The resulting formalism is therefore not introduced as an isolated symbolic expression but as the terminal mathematical consequence of the recursive admissibility architecture developed within the SEXA Unified Field Framework. Every subsequent computational evaluation, theorem, corollary, and numerical investigation follows directly from this derivation sequence under the assumptions and admissibility conditions established throughout the manuscript.

Appendix F

Mathematical Postulates, Open Problems, and Future Theorem Program

F.1 Purpose

The theorem-grade formalization presented throughout this manuscript establishes the recursive propagation functional under the assumptions, definitions, axioms, and theorem structure developed within the SEXA Unified Field Framework. The present appendix identifies the remaining mathematical problems whose resolution would further strengthen and extend the recursive propagation program.

These problems are intentionally presented as open mathematical questions rather than established results.

F.2 Open Problem I — Stability

Determine sufficient and necessary conditions under which the recursive propagation functional remains stable under arbitrary admissible perturbations of the recursive excitation amplitudes

$$\Psi_{\ell}.$$

In particular, determine whether there exists a universal stability bound

$$\delta$$

such that

$$\|\Delta V_{\text{Last}}^{(D)}\| < \delta$$

for every admissible perturbation satisfying the recursive admissibility conditions.

F.3 Open Problem II — Convergence

Determine whether recursive dimensional extension satisfies

$$D \rightarrow \infty$$

while preserving admissibility and finite recursive propagation.

Specifically, determine the convergence properties of

$$\lim_{D \rightarrow \infty} V_{\text{Last}}^{(D)}.$$

F.4 Open Problem III — Spectral Structure

Determine the spectrum of the recursive admissibility operator

$$\Gamma.$$

Characterize the eigenstructure governing recursively admissible propagation and identify invariant recursive subspaces associated with higher-dimensional transport.

F.5 Open Problem IV — Fixed Points

Determine whether recursively admissible manifolds possess fixed points satisfying

$$\Gamma(X) = X$$

under arbitrary recursive extension.

Characterize their existence, uniqueness, multiplicity, and stability.

F.6 Open Problem V — Topology

Construct the complete topological classification of recursively admissible manifolds.

Determine whether

$$\mathcal{M}^{(D)}$$

admits compact, connected, simply connected, or multiply connected recursive structures consistent with admissibility.

F.7 Open Problem VI — Computational Complexity

Although the present paper establishes linear evaluation complexity for direct computation, determine the optimal computational complexity of recursive propagation under symbolic simplification, parallel recursive evaluation, and higher-order recursive decomposition.

F.8 Open Problem VII — Independent Verification

Implement the recursive propagation functional using independently developed computational software.

The objective is to determine whether independent implementations reproduce identical recursive propagation values from identical admissible inputs.

F.9 Open Problem VIII — Experimental Correspondence

Develop experimentally testable predictions arising uniquely from the recursive propagation functional.

Such predictions should distinguish the recursive framework from alternative mathematical descriptions under clearly defined observational conditions.

F.10 Future Theorem Program

The present investigation establishes the mathematical foundation for a broader theorem program that may include, but is not limited to:

- Stability Theorem
- Convergence Theorem
- Spectral Theorem for Recursive Admissibility
- Fixed-Point Theorem
- Recursive Compactness Theorem
- Recursive Topology Classification Theorem
- Operator Algebra Theorem
- Harmonic Completeness Theorem
- Recursive Invariance Theorem
- Computational Complexity Theorem

Collectively, these investigations would extend the recursive propagation framework from a theorem-grade formalization of a single functional into a broader mathematical theory of recursively admissible manifold dynamics.

REFERENCES

I. Foundational Mathematics and Theoretical Physics

Newton, I. *Philosophiæ Naturalis Principia Mathematica* (1687). <https://archive.org/details/newtonprincipia>

Maxwell, J. C. *A Treatise on Electricity and Magnetism* (1873). <https://archive.org/details/treatiseonelectr01maxw>

Hilbert, D. *The Foundations of Physics* (1915).

Einstein, A. *The Foundation of the General Theory of Relativity* (1916).
<https://einsteinpapers.press.princeton.edu/vol6-trans/158>

Noether, E. *Invariant Variation Problems* (1918). <https://arxiv.org/abs/physics/0503066>

Dirac, P. A. M. *The Principles of Quantum Mechanics* (1930). <https://archive.org/details/principlesofquan0000dira>

von Neumann, J. *Mathematical Foundations of Quantum Mechanics* (1932).
<https://press.princeton.edu/books/hardcover/9780691028934/mathematical-foundations-of-quantum-mechanics>

Lee, J. M. *Introduction to Smooth Manifolds* (2nd Edition). <https://link.springer.com/book/10.1007/978-1-4419-9982-5>

Nakahara, M. *Geometry, Topology and Physics*.
<https://www.routledge.com/Geometry-Topology-and-Physics/Nakahara/p/book/9780750306065>

Penrose, R. *The Road to Reality*. <https://global.oup.com/academic/product/the-road-to-reality-9780198505495>

II. Prior SEXA Unified Field Framework Publications

McClain, J. *The SEXA Mathematical Framework: Unified Recursive Manifold Dynamics, Dimensional Collapse Operators, and Triality-Structured Exciter Geometry*. Journal of Advances in Mathematics.
<https://doi.org/10.24297/jam.v25i.9880>

McClain, J. *Formal Compatibility and Falsifiability of the SEXA Unified Field Framework*. Journal of Advances in Mathematics. <https://doi.org/10.24297/jam.v25i.9887>

McClain, J. *Hardware-Verifiable Recursive Computational Architecture Derived from the SEXA Unified Field Framework: Computational Correspondence, Recursive Admissibility, and Structured Validation Across a 2880-Dimensional Manifold*. Journal of Advances in Mathematics. <https://doi.org/10.24297/jam.v25i.9896>

McClain, J. *Gamma-Glyph Computation Theory: Ordered Admissibility Computation via Non-Commutative Constraint Chains*. <https://doi.org/10.5281/zenodo.19698748>

McClain, J. *Admissibility-Filtered Market Microstructure: Constraint-Governed Pre-Evaluation Filtering for Financial Signals*. <https://doi.org/10.5281/zenodo.19681939>

McClain, J. *Recursive Regime Dynamics: Harmonic Constraint Propagation and Nonlinear Market Regime Transitions*. <https://doi.org/10.5281/zenodo.19560822>

McClain, J. *Constraint-Native Financial Intelligence Systems: Admissibility-Governed Architectures for Real-Time Market Evaluation*. <https://doi.org/10.5281/zenodo.19423232>

McClain, J. *A Γ -Admissibility-Governed Unified Financial Energy Functional*. <https://doi.org/10.5281/zenodo.19387116>

McClain, J., & Ceisiwr, E. *The AMN Authority Tensor: Quaternionic Admissibility Enforcement, Glyph-Operator Constraint, and Planetary Closure in the SEXA Framework*. <https://doi.org/10.5281/zenodo.19632818>

III. Computational Mathematics and Algorithmic Foundations

Knuth, D. E. *The Art of Computer Programming*. <https://www-cs-faculty.stanford.edu/~knuth/taocp.html>

Cormen, T. H., Leiserson, C. E., Rivest, R. L., & Stein, C. *Introduction to Algorithms*. <https://mitpress.mit.edu/9780262046305/introduction-to-algorithms>

Wolfram, S. *A New Kind of Science*. <https://www.wolframscience.com/nk>

Mom,Dad,Thai & Daas Proto & Phairlever (and your Grandfather)..."The force will be with you, Always."

