Length–Mass Reduction (LMR) Theory
Paper I: Codex and Foundational Grammar

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Abstract

This paper establishes the foundational grammar of Length–Mass Reduction (LMR) theory. LMR is a dimensional reduction framework built around a bridge quantity, ℓm, defined by the product of mass and length and carrying units of $\mathrm{kg} \cdot \mathrm{m}$. The framework permits systematic reduction of SI expressions into dual representations, denoted A-side and B-side, without invoking physical interpretation or mechanism.

This paper introduces a formal dimensional grammar for Length–Mass Reduction (LMR), defining a dual representation framework in which SI quantities may be expressed on complementary sides through fixed algebraic routing rules. No physical interpretation, mechanism, or model is proposed; the paper serves exclusively to establish notation, admissibility, and structural consistency for subsequent work.

1 Introduction

Length–Mass Reduction (LMR) theory provides a formal grammar for reorganizing dimensional expressions derived from SI units. Rather than proposing new physical models, LMR defines a reduction procedure that maps quantities into dual representations while preserving algebraic structure. This paper serves as the codex for that procedure, establishing notation, diagrammatic coordinates, and reference tables used consistently throughout subsequent work.

2 Foundational Definitions

2.1 Bridge Quantity

LMR theory employs a bridge quantity, denoted ℓm, to formalize correspondence between length-based and mass-based dimensional descriptions. The bridge quantity is a construction device only. It is not a variable of the theory and does not appear in final equations or operational expressions. All quantities used in LMR are expressed without reference to ℓm.

The bridge quantity is defined by construction as the product of mass and length,

$$\ell m \equiv M\lambda,$$

and carries units of kg · m. This definition specifies the dimensional role of ℓm within the grammar and does not introduce a physical mechanism.

2.2 Dual Descriptions

LMR represents quantities using dual dimensional descriptions related by a fixed correspondence. These descriptions are denoted the A-side and the B-side. The A-side and B-side are not interpreted as physical domains or regions; they serve only to distinguish complementary representations within the dimensional grammar.

A quantity may admit one or both representations. When dual representations exist, they are related by a defined mapping and are treated as descriptions of the same object.

2.3 Mirror Inversion at mid_1

The correspondence between A-side and B-side descriptions is formalized by mirror inversion at mid_1. The mid_1 operator defines a one-to-one mapping between representations without implying motion, transport, or causality.

A-side and B-side are related by inversion at mid_1 and represent dual descriptions of the same object; quantities do not transfer across sides.

The mid_1 operator functions purely as a structural mapping within the grammar.

2.4 Notation and Representation Rules

When units are written explicitly, the canonical ordering kg, m, s, C is used to preserve alignment with the LMR reduction axes.

LMR employs explicit notational conventions to distinguish dimensional representations.

- If no prime ($'$) or double prime ($''$) is present, the quantity and its units are interpreted in standard SI form.
- A single prime ($'$) denotes an A-side representation. Quantities carrying a single prime differ from their SI form by application of the LMR dimensional grammar.
- A double prime ($''$) denotes a B-side representation. Quantities carrying a double prime differ from their SI form by mirror inversion at mid_1.

Primes and double primes serve only to distinguish representations. They do not indicate physical modification, hierarchy, dynamics, or location.

Mass admits an A-side representation denoted M', defined by

$$M' \equiv \frac{M}{\ell m}.$$

This relation specifies representation only and does not constitute a transformation, rescaling, or approximation. The resulting units are m^{-1}.

Time is invariant under representation and is written without primes.

Boundary-only, dimensionless, and topological constructs are written without SI units.

2.5 Scope of Definitions

The definitions in this section establish the complete grammatical framework used throughout LMR theory. No physical interpretation, mechanism, or application is implied by these definitions. Subsequent papers apply this grammar within specific contexts without altering the rules established here.

3 Notation Codex Rule

This paper employs a fixed notational codex to distinguish dimensional representations within the LMR framework. The codex applies uniformly across all sections and appendices and is not subject to contextual reinterpretation.

3.1 Prime Notation

Prime notation is used solely to distinguish side-specific representations.

- An unprimed quantity denotes a standard SI representation.
- A single prime ($'$) denotes an A-side representation.
- A double prime ($''$) denotes a B-side representation.

Primes do not indicate differentiation, hierarchy, perturbation, or physical modification. They serve only as grammatical markers within the dimensional framework.

3.2 Side Admissibility

Not all quantities admit representations on both sides. The presence or absence of a primed form is determined by the grammar and is documented explicitly in the appendices.

Quantities that do not admit side-specific representation remain unprimed in all contexts.

3.3 Equality by Construction

When both A-side and B-side representations exist for a given quantity, they are related by construction and represent the same object within the grammar. Side-specific representations are not required to be numerically equal to the corresponding SI quantity.

3.4 Boundary and Topological Quantities

Boundary-only, dimensionless, and topological constructs are written without SI units and without prime notation. Such quantities are invariant under side representation and do not participate in dimensional reduction.

3.5 Codex Authority

The notation rules defined in this section are authoritative. All subsequent papers adopt this codex without modification. Any extension of notation is additive and does not alter the definitions established here.

4 Visual Grammar

LMR employs diagrammatic structures as formal components of the grammar. Diagrams are not illustrative aids; they define coordinate systems used to route quantities and representations within the framework. All diagrammatic references in this paper and subsequent papers refer exclusively to the canonical forms presented here.

4.1 Quadrant Grammar

The quadrant grammar is value-agnostic. No physical quantities are implied by the positions A, B, C, or D. The diagram establishes structural rules only and serves as a primitive operator within the LMR framework.

4.2 Quadrant Routing Rules

The quadrant diagram defines a primitive multiplicative grammar based on reciprocal pairing. The diagram consists of four abstract slots, denoted A, B, C, and D, arranged symmetrically about a central intersection.

Define an axis-reflection operator as an inversion acting on a positional slot assignment, where the inversion center is fixed by the axis crossed. Routing within the quadrant diagram obeys the following fixed rules:

- Horizontal reflection applies ℓm-mediated inversion, exchanging mass and length dimensions while preserving left–right position.
- Vertical reflection applies unity-centered reciprocal inversion, preserving dimensional family while exchanging upper–lower position.

In both cases, the routing operation is an algebraic inversion governed by the crossed axis; no dynamics, transport, or physical interpretation is implied.

Diagonal routing is the composition of horizontal and vertical reflections. As a double application of reciprocal inversion, it returns a quantity to a multiplicatively equivalent form.

These routing rules are purely grammatical and define structural relationships only.

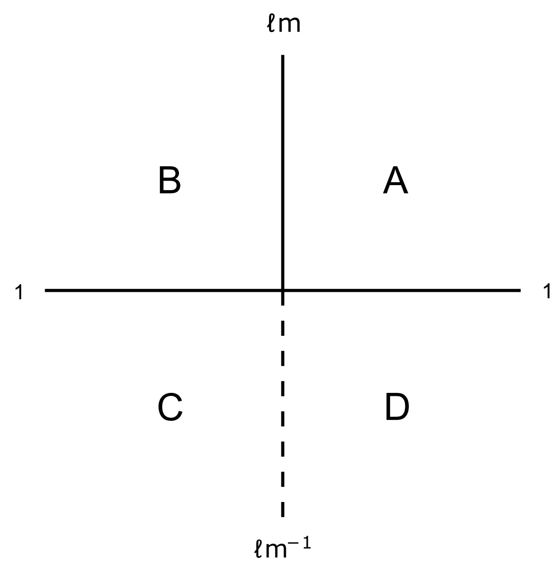

Figure 1: Quadrant diagram defining abstract reciprocal and multiplicative routing among four positions.

4.3 Hourglass Grammar

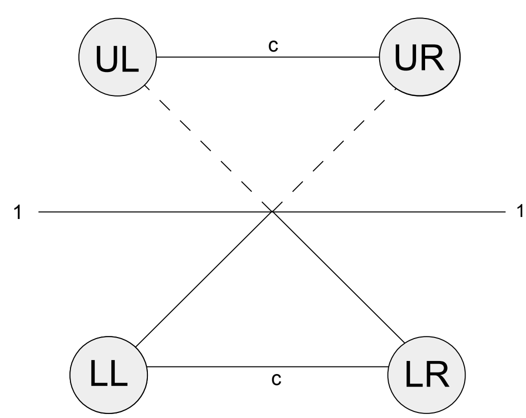

Figure 2: Canonical hourglass diagram defining positional slots and mirror inversion at mid_1.

Each slot represents a distinct grammatical position. Quantities may occupy one or multiple slots depending on admissibility defined by the codex. The hourglass diagram is invariant across contexts; different quantities occupy the same slots without altering the underlying structure.

4.4 Mirror Routing Rules

Mirror routing defines the formal inversion relationships between positional slots across the central mirror at mid_1. The mirror is a structural boundary only; it does not represent transport, causation, or dynamics.

The routing rules are fixed and apply universally within the LMR framework:

- The reciprocal of the quantity occupying UL maps to LR.
- The reciprocal of the quantity occupying UR maps to LL.

These mappings are involutive: applying the mirror operation twice returns a quantity to its original slot.

Mirror routing operates independently of numerical value, unit system, or physical interpretation. Only quantities whose admissibility is defined within the codex may occupy slots and undergo routing.

The mirror at mid_1 functions as a grammatical inversion operator within the hourglass grammar. It enforces reciprocal structure while preserving relational consistency across the diagram.

5 Worked Correspondences

This section provides worked correspondences illustrating the proper use of the LMR grammar. These examples are purely dimensional and grammatical. No numerical values, physical interpretation, or dynamical meaning is implied.

The purpose of these correspondences is to demonstrate correct reduction practice, admissible routing, and the role of the bridge quantity ℓm as a dimensional operator only.

5.1 Example 1: Reduction of Mass

Start with mass expressed in SI units:

$$M \ [\text{kg}]$$

Reduction by the bridge quantity ℓm (with units $\text{kg} \cdot \text{m}$) yields the A-side representation:

$$M' = \frac{M}{\ell m} \ [\text{m}^{-1}]$$

This defines the reduced mass (A-side representation) M', which occupies the upper-left (UL) slot in the hourglass grammar. No physical meaning is assigned; the result is a grammatical relocation with transformed units.

5.2 Example 2: Reduction of Length

Start with length expressed in SI units:

$$\lambda \text{ [m]}$$

Reduction by the bridge quantity yields the B-side representation:

$$\lambda'' = \frac{\lambda}{\ell m} \text{ [kg}^{-1}\text{]}$$

This defines the reduced length (B-side) representation λ'', which occupies the lower-right (LR) slot in the hourglass grammar. As above, this is a structural operation only.

5.3 Example 3: Reduction of Action

Consider action expressed in SI units:

$$h \text{ [kg} \cdot \text{m}^2 \cdot \text{s}^{-1}\text{]}$$

Reduction by one power of ℓm yields: (A-side)

$$\frac{h}{\ell m} \text{ [m} \cdot \text{s}^{-1}\text{]}$$

Reduction by a second power of ℓm yields: (B-side)

$$\frac{h}{\ell m^2} \text{ [kg}^{-1} \cdot \text{s}^{-1}\text{]}$$

These examples illustrate higher-order reductions of action under repeated application of the bridge quantity. They are presented here as dimensional correspondences only, without interpretive or physical assignment.

5.4 General Reduction Pattern

For any quantity Q expressed in SI units, reduction by integer powers of ℓm, either as division or multiplication depending on routing direction:

$$\frac{Q}{\ell m^n}$$

Such reductions reorganize dimensional emphasis while preserving internal consistency. Some reduced forms align naturally with established grammatical slots in the LMR diagrams; others may serve as inputs for future extensions, reinterpretations, or domain-specific applications.

No restriction on application context is imposed here. The present paper specifies the reduction grammar only; applications and interpretations are developed elsewhere.

A Appendix A: Fundamental Constants

Numerical and Representational Status. The quantities listed in Table 1 are presented solely as *grammatical representatives* within the Length–Mass Reduction (LMR) codex. All A-side and B-side entries are obtained by formal application of the reduction grammar defined in Sections 2–4 and classified by species in Appendix D. Numerical values appearing in reduced columns do not represent independently measured constants, alternative physical regimes, or new empirical parameters; they arise uniquely from algebraic dimensional routing under the LMR grammar. The bridge quantity ℓm is included for reference only and does not constitute an admissible quantity under the grammar; it does not appear in operational expressions or final equations. Equality or inequality among SI, A-side, and B-side values is determined exclusively by species classification, with species S4 satisfying $Q' = Q'' \neq Q$ by construction and species S3 satisfying $Q' \neq Q''$.

Table 1: Fundamental constants. SI, A-side, and B-side representations; significant figures preserved. ℓm listed for reference only.

Constant	**SI Value / Unit**	**A-side Value / Unit**	**B-side Value / Unit**
c	2.99792458×10^{8} m s^{-1}	2.99792458×10^{8} m s^{-1}	$1.35639248965 \times 10^{50}$ kg^{-1} s^{-1}
h	$6.62607015 \times 10^{-34}$ kg m^{2} s^{-1}	2.99792458×10^{8} m s^{-1}	$1.35639248965 \times 10^{50}$ kg^{-1} s^{-1}
G	6.67430×10^{-11} m^{3} kg^{-1} s^{-2}	—	—
$\sqrt{G}$	—	$\sqrt{G'}$ m^{2} s^{-1}	$\sqrt{G''}$ kg^{-2} s^{-1}
Charge (q; reduced $q' = q''$)	$1.602176634 \times 10^{-19}$ C	$1.32621132174 \times 10^{-18}$ C$'$	$1.32621132174 \times 10^{-18}$ C$''$
ε_0	$8.8541878128 \times 10^{-12}$ kg^{-1} m^{-3} s^{2} C^{2}	$1.95696949684 \times 10^{-53}$ m^{-2} s^{2} C$'^{2}$	$9.55992993645 \times 10^{-137}$ kg^{2} s^{2} C$''^{2}$
μ_0	$1.25663706212 \times 10^{-6}$ kg m C^{-2}	$5.68557689761 \times 10^{35}$ C$'^{-2}$	$5.68557689761 \times 10^{35}$ C$''^{-2}$
$\sqrt{\varepsilon_0}$	—	$4.42376479578 \times 10^{-27}$ m^{-1} s C$'$	$9.77748942032 \times 10^{-69}$ kg s C$''$
$\sqrt{\mu_0}$	—	$7.54027645223 \times 10^{17}$ C$'^{-1}$	$7.54027645223 \times 10^{17}$ C$''^{-1}$
r_e	$2.8179403262 \times 10^{-15}$ m	$2.8179403262 \times 10^{-15}$ m	$1.274959707 \times 10^{27}$ kg^{-1}
ℓm (reference)	$2.21021909430 \times 10^{-42}$ kg m	—	—

B Appendix B: Particle Codex Tables

Tabular Interpretation. Numerical values in Appendix B reflect grammatical reduction only. Equality or inequality across SI, A-side, and B-side columns follows directly from species classification and does not imply physical equivalence.

Table 2: Electron (e^-). SI, A-side, and B-side values and units.

Slot / Quantity	SI Value	SI Unit	A-side Value	A-side Unit	B-side Value	B-side Unit
LR : λ / λ''	$2.4263102358 \times 10^{-12}$	m	$2.4263102358 \times 10^{-12}$	m	$1.09776910446 \times 10^{30}$	kg^{-1}
UL : M / M'	$9.1093837190 \times 10^{-31}$	kg	$4.12148449106 \times 10^{11}$	m^{-1}	$9.1093837190 \times 10^{-31}$	kg
LL : t	$8.09329978335 \times 10^{-21}$	s	$8.09329978335 \times 10^{-21}$	s	$8.09329978335 \times 10^{-21}$	s
UR : f	$1.23558996549 \times 10^{20}$	s^{-1}	$1.23558996549 \times 10^{20}$	s^{-1}	$1.23558996549 \times 10^{20}$	s^{-1}
(energy) E / E' / E''	$8.18710578797 \times 10^{-14}$	$kg\,m^2\,s^{-2}$	$3.70420552835 \times 10^{28}$	$m\,s^{-2}$	$1.67594494949 \times 10^{70}$	$kg^{-1}\,s^{-2}$

Table 3: Proton (p^+). SI, A-side, and B-side values and units.

Slot / Quantity	SI Value	SI Unit	A-side Value	A-side Unit	B-side Value	B-side Unit
LR : λ / λ''	$1.32140985360 \times 10^{-15}$	m	$1.32140985360 \times 10^{-15}$	m	$5.97863739847 \times 10^{26}$	kg^{-1}
UL : M / M'	$1.67262192595 \times 10^{-27}$	kg	$7.56767476249 \times 10^{14}$	m^{-1}	$1.67262192595 \times 10^{-27}$	kg
LL : t	$4.40774882203 \times 10^{-24}$	s	$4.40774882203 \times 10^{-24}$	s	$4.40774882203 \times 10^{-24}$	s
UR : f	$2.26873181839 \times 10^{23}$	s^{-1}	$2.26873181839 \times 10^{23}$	s^{-1}	$2.26873181839 \times 10^{23}$	s^{-1}
(energy) E / E' / E''	$1.50327761802 \times 10^{-10}$	$kg\,m^2\,s^{-2}$	$6.80148688380 \times 10^{31}$	$m\,s^{-2}$	$3.07729079951 \times 10^{73}$	$kg^{-1}\,s^{-2}$

Table 4: Neutron (n). SI, A-side, and B-side values and units.

Slot / Quantity	SI Value	SI Unit	A-side Value	A-side Unit	B-side Value	B-side Unit
LR : λ / λ''	$1.31959090382 \times 10^{-15}$	m	$1.31959090382 \times 10^{-15}$	m	$5.97040767236 \times 10^{26}$	kg^{-1}
UL : M / M'	$1.67492750056 \times 10^{-27}$	kg	$7.57810619264 \times 10^{14}$	m^{-1}	$1.67492750056 \times 10^{-27}$	kg
LL : t	$4.40168145866 \times 10^{-24}$	s	$4.40168145866 \times 10^{-24}$	s	$4.40168145866 \times 10^{-24}$	s
UR : f	$2.27185908247 \times 10^{23}$	s^{-1}	$2.27185908247 \times 10^{23}$	s^{-1}	$2.27185908247 \times 10^{23}$	s^{-1}
(energy) E / E' / E''	$1.50534976514 \times 10^{-10}$	$kg\,m^2\,s^{-2}$	$6.81086218566 \times 10^{31}$	$m\,s^{-2}$	$3.08153259703 \times 10^{73}$	$kg^{-1}\,s^{-2}$

C Appendix C: Canonical Quantities and Reduction Species

This appendix lists commonly used physical quantities together with their standard SI units, reduced A-side and B-side unit forms, and reduction species as defined in Appendix D.

This table is declarative only. All reduction behavior, coincidence, and side admissibility follow solely from species classification.

Quantity	**SI Unit**	**A-side Unit**	**B-side Unit**	**Species**
Speed of Light c	$\mathrm{m\,s^{-1}}$	$\mathrm{m\,s^{-1}}$	$\mathrm{kg^{-1}\,s^{-1}}$	S_1
Mass m	kg	$\mathrm{m^{-1}}$	kg	S_2
Length λ	m	m	$\mathrm{kg^{-1}}$	S_1
Time t	s	s	s	S_0
Frequency f	$\mathrm{s^{-1}}$	$\mathrm{s^{-1}}$	$\mathrm{s^{-1}}$	S_0
Momentum p	$\mathrm{kg\,m\,s^{-1}}$	$\mathrm{s^{-1}}$	$\mathrm{s^{-1}}$	S_4
Energy E	$\mathrm{kg\,m^2\,s^{-2}}$	$\mathrm{m\,s^{-2}}$	$\mathrm{kg^{-1}\,s^{-2}}$	S_3
Force F	$\mathrm{kg\,m\,s^{-2}}$	$\mathrm{s^{-2}}$	$\mathrm{s^{-2}}$	S_4
Power P	$\mathrm{kg\,m^2\,s^{-3}}$	$\mathrm{m\,s^{-3}}$	$\mathrm{kg^{-1}\,s^{-3}}$	S_3
Action h	$\mathrm{kg\,m^2\,s^{-1}}$	$\mathrm{m\,s^{-1}}$	$\mathrm{kg^{-1}\,s^{-1}}$	S_3
Charge q	C	$\mathrm{C'}$	$\mathrm{C''}$	S_4
Current I	A	$\mathrm{C'\,s^{-1}}$	$\mathrm{C''\,s^{-1}}$	S_0
Voltage V	$\mathrm{kg\,m^2\,s^{-3}\,C^{-1}}$	$\mathrm{m\,s^{-3}\,C'^{-1}}$	$\mathrm{kg^{-1}\,s^{-3}\,C''^{-1}}$	S_3
Resistance R	$\mathrm{kg\,m^2\,s^{-3}\,C^{-2}}$	$\mathrm{m\,s^{-3}\,C'^{-2}}$	$\mathrm{kg^{-1}\,s^{-3}\,C''^{-2}}$	S_3
Permeability μ_0	$\mathrm{kg\,m\,C^{-2}}$	$\mathrm{C'^{-2}}$	$\mathrm{C''^{-2}}$	S_4
Permittivity ε_0	$\mathrm{kg^{-1}\,m^{-3}\,s^2\,C^2}$	$\mathrm{m^{-2}\,s^2\,C'^2}$	$\mathrm{kg^2\,s^2\,C''^2}$	

Notes

- Species labels refer to Appendix D.
- Quantities of species S_4 satisfy $Q' = Q'' \neq Q$.
- Quantities of species S_0 are invariant under reduction.
- Blank entries indicate non-admissible sides.
- Numerical values, where required, appear only in Appendix B.

D Appendix D: Reduction Species and Side Classification

This appendix specifies the classification of dimensional quantities under the Length–Mass Reduction (LMR) grammar. All statements concern dimensional structure only and are independent of physical interpretation, mechanism, or empirical model.

D.1 Base-Unit Expansion Rule

Every quantity Q is classified by its expansion into base units,

$$Q \sim \mathrm{kg}^a\,\mathrm{m}^b\,\mathrm{s}^c\,\mathrm{C}^d,$$

where electrical current is written explicitly as

$$\mathrm{A} \equiv \mathrm{C}\,\mathrm{s}^{-1}$$

prior to classification.

Species assignment depends only on the ordered pair (a, b). Time and charge exponents do not affect species classification.

This procedure is SI-blind: derived unit names (N, J, V, etc.) are not used.

D.2 Side-Target Principle

Reduction under the LMR grammar proceeds with a single objective:

- A-side reduction eliminates mass dimension ($a \to 0$).
- B-side reduction eliminates length dimension ($b \to 0$).

No other dimensional manipulation is permitted.

D.3 Reduction Species

Each quantity belongs to exactly one reduction species:

Species	**Dimensional Condition** (a, b)	**Side Behavior**
S_0	$(0, 0)$	SI-invariant
S_1	$(a, 0),\ a \neq 0$	A-side only
S_2	$(0, b),\ b \neq 0$	B-side only
S_3	$(a, b),\ a \neq b$	Dual: $Q' \neq Q''$
S_4	$(a, a),\ a \neq 0$	Coincident: $Q' = Q''$

D.4 Coincident Reduction Axiom

For any quantity Q belonging to species S_4,

$$Q' \equiv Q''.$$

This equality is both grammatical and numerical. It follows directly from the reduction rule: either side reduction eliminates mass and length simultaneously.

The reduced form satisfies

$$Q' = Q'' \neq Q.$$

D.5 Boundary-Derived Quantities

A quantity whose surface SI unit omits kg and/or m may nevertheless belong to species S_1–S_4 when expanded into base units.

Species classification is determined exclusively by base-unit expansion.

D.6 Charge Axiom

Charge is treated as a boundary-derived quantity.

Although written in coulombs (C), charge derives from electromagnetic constants whose base-unit expansions contain both mass and length dimensions.

Charge therefore belongs to species S_4 and satisfies

$$q' \equiv q'' \neq q.$$

No further explanation of charge is required within the codex.

D.7 Lookup Consistency Principle

Species classification uniquely determines admissibility, side behavior, and coincidence for all quantities listed in Appendix C.

No restriction on application context is imposed here.

D.8 Codex Authority

This appendix exhaustively specifies the reduction species and side classification rules of the LMR grammar.

These rules are final and authoritative for all subsequent work.

Primitive Topological Units

Half-fold. A *half-fold* denotes the minimal π-quantized curvature discontinuity admitted by the dual-manifold grammar and is treated as a primitive topological unit within Length–Mass Reduction (LMR).

Photon. Two half-folds forming a closed 2π circulation correspond to a photon, identified as the minimal radiative excitation of the A-side.

Multiplicative Scaling. Repeated composition of half-folds introduces a characteristic multiplicative scaling that recurs throughout LMR and appears in later structural results as powers of $\sqrt{c}$. No physical interpretation of this scaling is assumed in the present work.

Codex Lock Declaration.

This paper exhaustively specifies the dimensional grammar, notation, mirror rules, diagrammatic structure, and reduction species of Length–Mass Reduction (LMR) theory. All subsequent papers adopt this codex without modification. No later work redefines, extends, or alters the rules established here; all applications proceed strictly by instantiation within the grammar fixed in this paper.

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