Paper IV: Electromagnetic Routing and Projection

Length–Mass Reduction (LMR)

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Abstract

This paper develops the electromagnetic routing layer within the Length–Mass Reduction (LMR) framework. Building on the lattice grammar, persistence conditions, and primitive configurations established in Papers I–III, it identifies the structural conditions under which a persistent but asymmetric configuration becomes externally legible. Electromagnetic projections arise as admissible projections of lattice structure through an open half-fold, rather than as forces, fields, or carriers.

The exposition remains pre-dynamical. No equations of motion, energetic assumptions, or field postulates are introduced. Electromagnetic behavior is presented as an external routing grammar governed by admissibility gradients and projection constraints. This treatment prepares the ground for the normalization and inflow grammar developed in Paper V. Any dynamical interpretation is deferred to observer-side overlays and does not enter the predynamical LMR framework.

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1 Introduction

Paper IV addresses the emergence of electromagnetic structure within the Length–Mass Reduction (LMR) framework. Papers I–III established the lattice grammar, persistence conditions, and primitive configurations required for stable asymmetric structure [**Rollins2025Codex**, **Rollins2026Persistence**, **Rollins2026Emergence**]. What remains unresolved after those developments is how a persistent configuration becomes externally legible once asymmetry is admitted but not internally closed.

This paper resolves that question at the level of structure. It introduces no new primitives and modifies none of the structural conclusions of earlier work. Instead, it identifies and constrains an additional routing layer that becomes admissible only in the presence of an open half-fold. This layer specifies how lattice admissibility is projected externally, giving rise to phenomena conventionally grouped under electromagnetic behavior.

The treatment remains structural throughout. No appeal is made to classical field theory, quantum electrodynamics, or empirical laws. Electromagnetic projections are derived as necessary projection signatures of an already persistent configuration, not as fundamental agents. In this sense, Paper IV continues the structural program initiated in Paper III by exposing how persistence becomes externally legible without invoking dynamics.

The present paper retains the codex-level A-side/B-side correspondence, but works operationally through the λ- and M'-faces of the populated structural layer.

2 Placement of the Electromagnetic Layer in the Hourglass

The electromagnetic (EM) layer is introduced as the outermost structural layer of the LMR hourglass. Its role is not to govern dynamics or interaction, but to provide a projection surface through which certain middle-layer asymmetries become externally accessible.

The hourglass structure therefore admits three distinct layers:

1. an inner lattice layer, responsible for admissibility inflow and persistence support;
2. a middle structural layer, populated by the quantities (M', f, t, λ) and governed by closure, routing, and torsion constraints;
3. an outer electromagnetic layer, in which selected routing asymmetries of the middle layer are externalized as observable signatures.

The EM layer does not act upon the middle layer, nor does it modify its admissibility. Rather, it registers how unresolved structural features of the middle layer are expressed when admissibility cannot be internally closed. In this sense, the EM layer is not an independent physical domain but a projection of middle-layer structure onto an external routing surface.

This distinction is essential. The EM layer introduces no new structural degrees of freedom. All admissible configurations are determined entirely within the lattice and middle layers. The EM layer merely specifies how certain configurations appear when structural asymmetry is present.

Remark 2.1 (Representation discipline). Within Papers III–V, the structural dual of the λ-face is the M'-face with

$$M' = \frac{1}{\lambda}.$$

Any kg-faced discussion is treated as a measurement embedding only and is not required for the predynamical structural program.

3 Electromagnetic Routing Layer

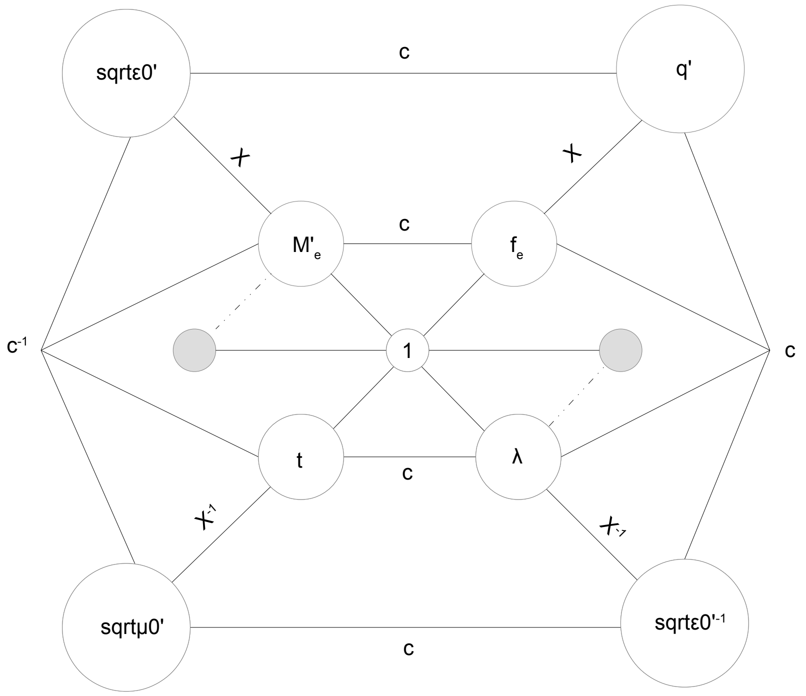

Figure 1: Extended hourglass diagram with electromagnetic routing layer.
The diagram reprises the structural hourglass introduced in Papers I–III, now augmented by an outer electromagnetic layer. The middle layer contains the persistent configuration, organized by structural length, timing, and normalization under the invariant lattice baseline c. The outer layer depicts admissible electromagnetic projections $\sqrt{\varepsilon_0'}$, $\sqrt{\mu_0'}$, $\sqrt{\varepsilon_0'^{-1}}$, and q', shown here for orientation only. No dynamical, field-theoretic, or energetic interpretation is implied. The diagram serves as a structural map, not a model of motion or interaction.

Once a persistent configuration retains unresolved asymmetry without internal closure, a merely internal description is no longer sufficient to account for its externally legible routing status. The outer layer is therefore not an added mechanism, but the minimal projection surface on which externally legible asymmetry appears.

Placement precedes interpretation: symbols shown in the outer layer are positional before they are phenomenological.

Because the middle layer already fixes the persistent configuration and its unresolved asymmetry, the outer layer cannot introduce a second structural mechanism without violating the discipline of Papers I–III. The externalization of that asymmetry must therefore occur through a single projection corridor. The role of X is not to add behavior, but to expose one already-admitted routing status at the projection surface.

4 The Electromagnetic Corridor X

The connection between the middle structural layer and the electromagnetic layer is specified by a single corridor, denoted X. This corridor defines how admissible routing in the middle layer is projected into electromagnetic representation.

The corridor X specifies the projection relation by which admissible routing in the middle layer becomes represented in electromagnetic form.

The corridor X has A-side dimensions

$$X : [s \cdot C']$$

and functions as a projection operator rather than a transport mechanism. It does not mediate interaction, transmit influence, or generate forces. Instead, it encodes how timing and structural asymmetry in the middle layer appear as electromagnetic signatures.

Structurally, the corridor X admits the following projection identity:

$$q' = f \times X,$$

where f is the middle-layer structural frequency and q' is the electromagnetic charge signature. This identity expresses that charge is not a primitive substance but the externalized projection signature of unresolved structural frequency.

The inverse corridor X^{-1} specifies the complementary magnetic routing channel, mapping middle-layer length into electromagnetic representation. Together, X and X^{-1} satisfy the involution constraint

$$X \times X^{-1} = 1,$$

ensuring that electromagnetic projection and retraction are structurally consistent.

It is emphasized that X is not a field operator, coupling constant, or dynamical parameter. The electromagnetic layer emerges solely through the application of X to admissible middle-layer configurations and carries no independent ontology.

Paper IV extends the structural framework developed in Papers I–III by exposing an additional routing layer external to the middle hourglass configuration. The purpose of this opening is not to introduce new mechanisms or interpretations, but to re-orient the reader within a familiar geometric grammar that now admits further structural articulation. The hourglass remains the organizing scaffold: quantities are placed according to admissible routing relationships, not explanatory function.

4.1 EM normalization as a derived closure (no new corridors)

Definition 4.1 (EM corridor and charge projection)**.** The electromagnetic corridor is the projection corridor X. Charge is the externalized routing signature defined by

$$q' := f\,X.$$

Definition 4.2 (Derived electric normalization $\sqrt{\varepsilon_0'}$)**.** Define the electric normalization as the corridor-composite

$$\sqrt{\varepsilon_0'} := M'\,X \qquad \Big(= \frac{X}{\lambda}\Big).$$

This is a normalization identity: it introduces no additional corridor beyond X and uses only the middle-layer primitive $M' = 1/\lambda$.

Corollary 4.3 (The c-closure ratio)**.** *The ratio of the two EM-facing quantities is fixed by the c-corridor:*

$$\frac{q'}{\sqrt{\varepsilon_0'}} = \frac{fX}{M'X} = \frac{f}{M'} = c.$$

Thus the X corridor cancels, and the c-closure is a structural identity of the middle layer under EM projection.

Definition 4.4 (Derived magnetic dual normalization $\sqrt{\mu_0'}$)**.** Define $\sqrt{\mu_0'}$ as the unique dual normalization that closes with $\sqrt{\varepsilon_0'}$ under the c-corridor:

$$\sqrt{\varepsilon_0'}\,\sqrt{\mu_0'} \;:=\; \frac{1}{c}.$$

Equivalently,

$$\sqrt{\mu_0'} \;=\; \frac{1}{c\,\sqrt{\varepsilon_0'}} \;=\; \frac{1}{c\,M'X} \;=\; \frac{\lambda}{c\,X}.$$

Remark 4.5 (What is and is not determined here). This closure does *not* introduce a new primitive. Rather, it fixes $\sqrt{\mu_0'}$ as the *dual* of $\sqrt{\varepsilon_0'}$ given the already-admitted corridor c.

Numerical coefficients associated with SI conventions (e.g. 4π packaging) are not asserted here as structural content; they are treated as representational faces of the SI embedding, not additional LMR corridors.

This is a normalization identity: it introduces no additional corridor beyond X and uses only the middle-layer primitive $M' = 1/\lambda$. No independent electromagnetic projection is introduced at this stage.

Geometric realization of the charge signature (no new corridor). The charge quantity q' is defined structurally by

$$q' := fX,$$

and therefore remains a routed projection of middle-layer structure through the corridor X.

At the level of A-side geometric scaling, q' admits a derived representation in terms of the lattice primitive c:

$$q'_{\text{geom}} = \frac{1}{9c^2}.$$

This expression is not introduced as a replacement for q' and does not define a new primitive or routing operator. It is a derived geometric realization consistent with the existing projection identity.

Interpretive restraint. The form $q'_{\text{geom}} = 1/(9c^2)$ should be read strictly as a scaling identity within the A-side grammar. It does not alter the definition $q' = fX$, nor does it introduce a second electromagnetic corridor.

The corridor X remains the unique projection operator connecting the middle layer to electromagnetic representation.

5 Charge as a Structural Routing Signature

Charge is not a material property, source term, or conserved substance. It is a structural signature associated with configurations that retain an unresolved routing asymmetry in the middle layer.

The electron-class configuration is treated here as the minimal persistent asymmetric configuration established in Paper III [**Rollins2026Emergence**]. The electron possesses three half-folds, one of which remains structurally open. This open half-fold prevents full internal closure and admits external routing. The electromagnetic charge signature q' is the projection signature of this unresolved admissibility.

Configurations with no open half-fold admit no projection through X. In particular:

- the proton, with four internally closed half-folds, admits no q';
- the neutron, with torsion-locked closure, admits no external q';

- loop photons, composed of two closed half-folds, carry no charge signature.

Charge therefore reflects neither attraction nor repulsion. It is a marker of selective admissibility: unresolved structure that cannot be internally closed appears through the electromagnetic layer. This selectivity distinguishes electromagnetic routing from gravitational routing, which admits no orientation or preference and will be treated separately.

The electromagnetic layer does not cause persistence, nor does it enforce closure. It merely records how unresolved structure is externalized. Charge is thus a boundary quantity: it belongs neither to the lattice nor to the middle layer alone, but to their projection through the corridor X.

Positional Orientation and Interpretive Restraint

Accordingly, symbols associated with the electromagnetic sector are displayed at the outset. Their appearance should be read as positional rather than descriptive or causal. As in earlier papers, structure precedes interpretation; the reader is asked only to recognize where new quantities reside relative to previously established corridors, not to infer their behavior.

With this extended hourglass as a point of orientation, we now develop the structural origin of electromagnetic admissibility, beginning from the minimal asymmetric configuration and its interface with the environment.

The present section does not revise the electron-class structure established in Paper III; it identifies the external routing face that becomes admissible once that open interface persists.

Part I

Selective Admissibility and Electromagnetic Structure

Definition 5.1 (Admissibility Gradient)**.** An *admissibility gradient* is a structural condition in which the availability of lattice routing differs across admissible paths relative to a persistent configuration.

Formally, an admissibility gradient exists whenever redirected lattice structure encounters unequal admissibility among neighboring routes, such that structural resolution admits one continuation while excluding another.

An admissibility gradient does not constitute motion, force, or field. It represents neither stored energy nor propagation. It is instead a statement about relative structural permission: which lattice continuations are allowed, suppressed, or redirected by a given configuration.

Proposition 5.2 (Admissibility Gradient Realization)**.** *An admissibility gradient may be sustained only by a persistent configuration that retains an unresolved half-fold.*

Internally closed configurations do not admit admissibility gradients. They may redirect lattice structure by reflection, but cannot sustain differential admissibility across routes.

Consequently, among the primitive persistent configurations introduced in Paper III, only the electron-class configuration admits the structural preconditions necessary to realize an admissibility gradient.

6 Selective Versus Uniform Admissibility

Electromagnetic structure arises when admissibility is *selectively redirected* rather than uniformly available. When unresolved interfaces coexist, admissibility is not uniformly available across all routing paths. The resulting imbalance is structural and comparative, not dynamical.

By contrast, some admissible configurations do not admit orientation, competition, or redirection. Such configurations may route admissibility uniformly, without preference or exclusion. These distinctions are structural and are introduced here only to delimit electromagnetic behavior, without invoking mechanisms, transport, or interaction.Uniform admissibility admits no orientation, exclusion, or competition between routing permissions.

7 Charge Polarity as Routing Orientation

Charge polarity does not represent a substance, carrier, or intrinsic sign. It records the orientation of admissibility redirection relative to a reference loop-photon frame and is therefore relational, not intrinsic.

Two configurations possess *like polarity* when their admissibility redirections compete for the same routing permissions. They possess *opposite polarity* when their redirections are complementary and permit coexistence.

Attraction and repulsion therefore arise from compatibility or incompatibility of admissibility redirection, not from force, exchange, or field mediation.

8 Electron Uniqueness in Electromagnetic Participation

Only electron-class configurations admit projection through the electromagnetic corridor.

This follows from three structural facts:

1. the electron possesses an unresolved half-fold,
2. this half-fold permits admissibility redirection,
3. the electron admits no internal closure that resolves or eliminates this redirection.

Other configurations may geometrically constrain admissibility, but they do not themselves redirect it. Accordingly, electromagnetic structure is realized only where unresolved interfaces persist.

9 External Suppression Without Resolution

Admissibility redirection may be externally suppressed without being structurally resolved.

When an electron is seated on a proton basin, the open half-fold remains unresolved. Redirection persists, but its orientation is constrained by basin reflection. Suppression reflects geometric redirection, not closure.

Only when torsion locking eliminates the unresolved half-fold is admissibility redirection fully suppressed.

The free electron, the seated hydrogen configuration, and the torsion-locked neutron do not instantiate three different interface ontologies. They are three admissibility statuses of the same open-interface grammar: unrestricted redirection, constrained redirection, and structurally suppressed redirection.

10 Structural Classification of Charge-Admitting Configurations

Definition (Charge-Admitting Configuration)

A configuration is said to *admit charge* if and only if it retains an unresolved open half-fold interface capable of projection through the X corridor.

Formally, a configuration admits $q' \neq 0$ if and only if it contains exactly one open half-fold whose admissibility cannot be resolved by internal closure, loop-photon formation, or torsion locking.

Proposition (Electron-Class Uniqueness of q')

Within the primitive inventory of Papers I–IV, the electron-class configuration is the only persistent configuration that admits $q' \neq 0$.

Proof Sketch.

- The proton-class configuration contains four closed half-folds. No open interface remains; therefore $q' = 0$.
- The neutron-class configuration contains an electron-class structure whose open half-fold is torsion-locked and therefore does not externalize through X; hence $q' = 0$.
- Loop photons contain two half-folds in mutual closure and admit no open routing interface; hence $q' = 0$.
- Hydrogen-class seating restricts the electron open interface by phase cadence but does not introduce a second persistent open half-fold; q' remains attributable only to the electron-class structure itself.

Therefore, within the structural grammar established thus far, q' is admitted uniquely by electron-class configurations.

Corollary (Selectivity of the Electromagnetic Layer)

Unlike gravitational routing, which consumes unresolved admissibility independent of orientation, electromagnetic routing is selective. Only configurations retaining a single unresolved open half-fold interface admit projection through the X corridor.

Charge is therefore not a primitive substance. It is the projection signature of unresolved structural frequency.

11 Scope Limitation

This part establishes selective admissibility and redirection without invoking sector-specific mechanisms, constants, or routing corridors. Structural contrasts are introduced solely to define electromagnetic behavior and to prepare subsequent developments.

No claims are made here regarding dynamics, propagation, or gravitational routing, which are deferred to later work.

Part II

Electromagnetic Routing Without Fields

12 Admissibility Routing in the Outer Layer

Electromagnetic phenomena correspond to admissibility routed through the outer electromagnetic layer via the X corridor.

The outer layer does not introduce new primitives. It consists of external admissibility projected from persistent configurations.

No fields are assumed. No propagation medium is defined.

13 Mode-Based Routing Behavior

Two routing behaviors are structurally admissible:

13.1 Mode 1: Geodesic-Constrained Routing

In Mode 1 routing, admissibility proceeds along a single geodesic. No cross-geodesic displacement occurs, and no residual structure is generated.

Loop-photon configurations may persist across routing in this mode as nonpersistent structural records.

13.2 Mode 2: Cross-Geodesic Routing

In Mode 2 routing, admissibility resolves by crossing between adjacent geodesics. Such crossings are associated with residual lattice structure.

This residual structure coheres as a loop-photon configuration composed of two half-folds. The loop photon records the geometric displacement associated with the routing transition.

14 Photon Production as Destructive Bookkeeping

Loop photons are nonpersistent configurations. They admit lattice absorption without closure and therefore do not retain identity.

Photon production is destructive bookkeeping: it records admissibility reconfiguration and does not persist under further admissibility resolution. This does not preclude loop photons from participating in further admissibility reconfiguration.

No emission mechanism is postulated. Photon production follows necessarily from cross-geodesic admissibility resolution.

15 Boundary Filtering and Reconfiguration

When a loop photon encounters a configuration that admits only partial compatibility, filtering is admitted.

In such cases, the incident loop photon may be reconfigured into multiple loop photons of differing structural lengths, corresponding to selective admissibility retention.

Reflection, selective absorption, and fluorescence arise from this mechanism. No forces or fields are invoked. The redistribution of admissibility described here does not yet include environmental inflow or persistence bias; those mechanisms are introduced in Paper V.

15.1 Complementary Interface Closure: Pair Production and Annihilation

The EM layer admits open-interface orientation as a structural signature. An open half-fold interface is characterized by an orientation label

$$\sigma \in \{A, B\},$$

where A and B denote complementary admissible facings. The charge signature q' records the presence of such an unresolved open interface externalized through the X corridor.

Two configurations whose open interfaces are complementary admit a minimal closure channel. In structural form:

$$(\mathrm{HF}, A) \oplus (\mathrm{HF}, B) \rightsquigarrow LP(\lambda),$$

where $LP(\lambda)$ denotes a loop-photon record composed of two half-folds. This closure corresponds to the replacement of complementary open interfaces by a closed destructive record.

Annihilation (Structural Statement). When two complementary open-interface configurations are co-present in an admissible environment, their unresolved interfaces admit replacement by closed loop-photon records. The dominant minimal closure channel is

$$e^- \oplus e^+ \rightsquigarrow LP(\lambda_1) \oplus LP(\lambda_2),$$

with any residual incompatibility redistributed into lattice binding. No disappearance of structure is implied; rather, open-interface asymmetry is replaced by closed two–half-fold records plus re-binding of the ambient geodesic structure.

Pair Production (Structural Statement). Conversely, a loop-photon record presented to a basin environment may admit reconfiguration into two complementary open-interface configurations,

$$B \oplus LP(\lambda) \rightsquigarrow B \oplus e^- \oplus e^+,$$

provided the basin admits the residual mismatch required for seating. The basin is not a force mediator but a structural scaffold that renders the seating operator admissible.

This bidirectional replacement establishes complementary interface closure as a purely structural property of the EM layer. Open interfaces do not vanish; they either:

1. close through complementary replacement into loop-photon records, or
2. redistribute into lattice binding when no persistent seating is admitted.

All statements remain pre-dynamical. No force, field, or equation of motion is invoked. Complementary interface closure is an admissible routing identity within the EM projection layer.

16 Half-Fold Complementarity and Pair Processes

Electromagnetic routing admits configurations whose unresolved half-fold interfaces are complementary. When two electron-class configurations of opposite routing orientation encounter one another, admissibility redirection may resolve by redistribution into the lattice.

This section formalizes pair production and annihilation as structural redistribution processes rather than as dynamical particle events.

The following structural description is equivalent to the complementary interface formulation given above, expressed without half-fold notation.

16.1 Half-Fold Complementarity

An electron-class configuration retains a single unresolved half-fold (HF). Let the orientation of this open interface be denoted $\sigma \in \{A, B\}$, representing complementary routing orientations relative to a loop-photon frame.

Two configurations are complementary when their open half-fold orientations are opposite:

$$\sigma_1 \neq \sigma_2.$$

Complementarity permits mutual admissibility resolution through redistribution into lattice structure. No new primitive is introduced; only routing orientation differs.

16.2 Pair Production as Reverse Redistribution

Conversely, when a loop-photon configuration encounters a basin, its half-folds may be separated by Mode-2 routing.

If the available admissible inventory exceeds the structural threshold required for two electron-class configurations, complementary open half-folds may be embedded into emerging configurations:

$$\mathrm{LP} + \mathrm{basin} \to e^- + e^+ + \mathrm{basin}.$$

The basin provides the structural anchoring required for geodesic separation; without a third-body anchor, admissible redistribution is not localized into two persistent electron-class configurations.

The threshold corresponds structurally to the admissible inventory necessary to sustain two unresolved half-fold interfaces. In conventional units, this corresponds to twice the electron mass.

16.3 Annihilation as Frame Release with Inline Closure

When complementary electron-class configurations encounter one another, admissible reconfiguration may resolve the two unresolved half-fold interfaces by inline return to the lattice. In this channel, the open half-folds do not introduce additional loop-photon residue. Rather, their complementarity permits direct geodesic-aligned redistribution into lattice structure.

The two observed photons correspond to the two loop-photon frames already seated within the incident configurations. Annihilation therefore releases these existing frames as loop-photon records, rather than producing new ones by Mode-2 residue formation:

$$e^- + e^+ \to 2\,\mathrm{LP}.$$

Accordingly, annihilation is not disappearance but re-seating: the unresolved interfaces are resolved by lattice return, while the pre-existing loop-photon frames detach and persist only as non-retained destructive bookkeeping records.

While the two–loop-photon channel is structurally minimal, alternative redistribution channels may become admissible under differing environmental constraints. Such channels depend on admissibility supply and boundary conditions and are not developed here.

16.4 Structural Symmetry Constraint

Pair production and annihilation are structurally inverse under redistribution symmetry:

$$e^- + e^+ \leftrightarrow 2\,\mathrm{LP}.$$

No force, carrier, or field exchange is invoked. The processes are consequences of admissibility routing and half-fold complementarity.

17 Scope Limitation

This part establishes electromagnetic phenomena as admissibility routing behavior. No Maxwell equations, potentials, or dynamical laws are invoked.

Structural Scope Reminder

The measurement framework developed below remains entirely within the A-side structural domain.

Electromagnetic projections (e.g. $q' = fX$) are projection signatures of routing and do not constitute field dynamics.

No probabilistic or collapse postulates are introduced.

Part III

Structural Completion of the Electromagnetic Sector

18 Scope of Part III

Parts I–III established the lattice grammar, persistence conditions, and the minimal persistent configurations of the LMR framework. Paper IV introduced the electromagnetic routing layer as the projection grammar through which unresolved middle-layer asymmetry becomes externally legible.

The electromagnetic corridor X projects admissible routing from the middle layer onto an outer representational surface. Within this surface, unresolved structural asymmetry appears as a charge signature:

$$q' := fX.$$

The electromagnetic layer introduces no forces, fields, transport mechanisms, or dynamical laws. It is a projection grammar only.

Part III completes the electromagnetic sector at the level of grammar. It addresses:

1. the internal closure structure of the electromagnetic layer once populated,
2. the structural relation among q', ε_0', and c,
3. the structural boundary of electromagnetic projection.

No new primitives or corridors are introduced.

19 Closure of the Electromagnetic Layer

Once populated through the projection corridor X, the electromagnetic layer admits an internal closure independent of projection.

Proposition 19.1 (EM closure circuit)**.** *The electromagnetic projections satisfy a closed routing circuit under the corridors c and mid_1:*

$$\sqrt{\varepsilon_0'} \overset{c}{\to} q' \xrightarrow{\mathrm{mid}_1} \sqrt{\mu_0'} \overset{c}{\to} \frac{1}{\sqrt{\varepsilon_0'}} \xrightarrow{\mathrm{mid}_1} \sqrt{\varepsilon_0'}.$$

Proof. Horizontal routing proceeds through the c-corridor. Vertical routing proceeds through mirror inversion at mid_1. Since mid_1 is involutive and the c-corridor appears together with its reciprocal closure, the circuit returns to its starting quantity. The circuit is therefore closed. ☐

Remark 19.2. The corridor X is required to populate the electromagnetic layer but does not participate in its internal closure. Projection establishes the layer; closure governs its internal structure.

20 The Electromagnetic Closure Condition

Definition 20.1 (Electromagnetic closure condition)**.**

$$q'^2 = \varepsilon_0' c^2, \qquad q' = c\sqrt{\varepsilon_0'}.$$

Proposition 20.2. *This condition follows from the projection identities*

$$q' = fX, \qquad \sqrt{\varepsilon_0'} = M'X,$$

together with the hourglass relation

$$f = M'c.$$

Proof.

$$\frac{q'}{\sqrt{\varepsilon_0'}} = \frac{fX}{M'X} = \frac{f}{M'} = c.$$

Thus $q' = c\sqrt{\varepsilon_0'}$, and squaring gives the result. □

Remark 20.3. The cancellation of X expresses that internal electromagnetic closure is governed by the same c-structure as the middle layer once projection has occurred.

Remark 20.4. This identity is structural. It is not a field equation, force relation, or propagation law.

Remark 20.5. The closure condition reduces to a middle-layer identity once projection is removed. It does not introduce a new electromagnetic relation.

21 Closure Ratio

Definition 21.1.

$$\rho_{\text{closure}} := \frac{q'^2}{2\varepsilon_0' c^2}.$$

Proposition 21.2.

$$\rho_{\text{closure}} = \frac{1}{2}.$$

Remark 21.3. This value is a boundary condition of the closed electromagnetic grammar. It is not a measured coupling or empirical constant.

Remark 21.4. This value is not the fine-structure constant and does not replace it. It is a structural boundary condition of the closed electromagnetic grammar.

22 Geometric Charge Readout

Definition 22.1.

$$q'_{\text{geom}} := \frac{1}{9c^2}.$$

Remark 22.2. This quantity is a derived geometric scaling consistent with the projection identity $q' = fX$. It does not replace that definition and does not introduce a new corridor.

Remark 22.3. The geometric readout and the projection definition represent distinct structural descriptions of the same admissible quantity. They occupy different grammatical roles.

Remark 22.4. The geometric readout is not a defining relation and cannot be used in place of $q' = fX$. It is a consistency scaling within the A-side grammar only.

23 Structural Boundary of the Electromagnetic Sector

The electromagnetic sector is complete as a EM-facing closure grammar.

It accounts for:

- projection of structural asymmetry:
$$q' = fX,$$
- derived normalization:
$$\sqrt{\varepsilon_0'} = M'X,$$
- closure identity:
$$q'^2 = \varepsilon_0' c^2,$$
- closure ratio:
$$\rho_{\text{closure}} = \frac{1}{2},$$
- geometric readout:
$$q'_{\text{geom}} = \frac{1}{9c^2}.$$

It does not account for:

- persistence normalization,
- admissibility exhaustion,
- structural support of persistence.

Remark 23.1. The electromagnetic layer renders unresolved structure externally legible but does not resolve or sustain it.

Remark 23.2. The electromagnetic layer is externally legible but structurally incomplete.

Remark 23.3. Completion of persistence requires the normalization grammar introduced in Paper V.

24 Interpretive Guardrail

The electromagnetic sector developed in this paper is a projection grammar.

It does not describe:

- forces,
- fields,
- interactions,
- propagation,
- energy transfer.

All such interpretations belong to observer-side overlays and are not part of the predynamical LMR framework.

Paper IV develops the electromagnetic sector strictly as a projection grammar. It does not introduce forces, fields, or dynamical laws. Interpretation beyond projection and routing belongs to later work.

References

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If referring to specific structural definitions or prior results, please cite the corresponding paper in the LMR series in addition to this manuscript. Paper IV assumes the grammatical framework of Paper I, the persistence framework of Paper II, and the primitive structural configurations of Paper III unless explicitly stated otherwise.