Field Dressing and Observable Projection

Paper 5 of 5 in the Control–Structure Series

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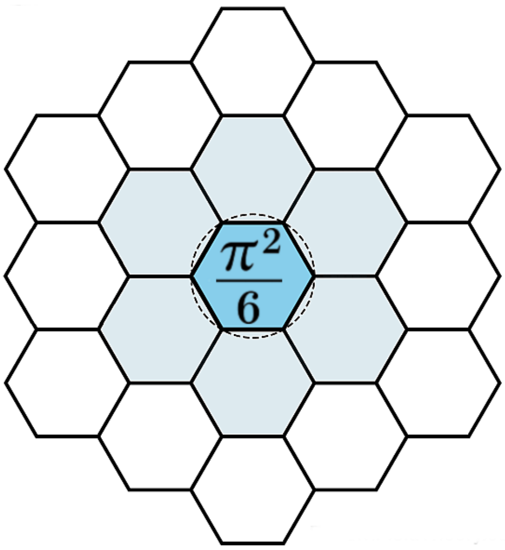


Abstract

This paper formalizes the projection from discrete identity-scale structure to continuous observable quantities within Pattern Field Theory. We introduce the field dressing operator as a non-linear, non-invertible mapping that resolves the disparity between model-space curvature load and empirical physical measurements. Observable mass, charge, and interaction asymmetries are shown to arise from structural dressing effects rather than intrinsic parameter inflation. This completes the Control–Structure Series by establishing a principled bridge between discrete admissible configurations and measured physical phenomena.

1 Series Context and Scope

This paper is the fifth and final paper in the Control–Structure Series. It builds directly on the structural update laws (Paper 1), irreversibility and scarring (Paper 2), governance and dormancy (Paper 3), and observer patterns with emergent continuity (Paper 4).

No new control primitives are introduced. This work addresses projection only: how discrete identity loads appear as continuous observables under interaction with ambient fields.

2 Identity-Scale Curvature Load

Definition 1 (Identity Curvature Load)**.** *Each admissible identity in Pattern Field Theory is assigned a discrete curvature load*

$$\kappa(p) = \log p,$$

where p is the prime index associated with the identity. This quantity exists purely in model space and is not directly observable.

Remark 1. *The curvature load $\kappa(p)$ is not a mass, energy, or charge. It is an index of structural demand required to maintain admissibility under* PAL*.*

3 The Need for Field Dressing

Empirical observables such as lepton mass ratios differ by orders of magnitude from identity-scale ratios. For example,

$$\frac{\kappa(p_\mu)}{\kappa(p_e)} = \frac{\log 5}{\log 2} \approx 2.32, \quad \frac{m_\mu}{m_e} \approx 206.77.$$

This discrepancy cannot be resolved through linear scaling.

Proposition 1. *Observable quantities are not linear functions of identity curvature load.*

Proof. If observables were linear in κ, identity ratios would be preserved. Empirical ratios violate this condition. Therefore the mapping must be non-linear. □

4 The Field Dressing Operator

Definition 2 (Field Dressing Operator)**.** *The field dressing operator*

$$m_{\text{obs}} = \mathcal{F}_{\text{dress}}(\kappa, \Delta_{\text{PAL}}, \Phi_{\text{vac}}, \chi_{\text{wk}}, \Delta R_Z)$$

maps identity-scale curvature load to observable quantities.

Remark 2. *The operator aggregates multiple interaction-layer effects, including vacuum polarization, weak chirality bias, and equilibrion displacement.*

Proposition 2 (Non-Invertibility)**.** *The dressing operator $\mathcal{F}_{\text{dress}}$ is non-injective. Distinct identity states may project to indistinguishable observables.*

Proof. There exist $x_1 \neq x_2$ such that $\mathcal{F}_{\text{dress}}(x_1) = \mathcal{F}_{\text{dress}}(x_2)$, due to compensating field contributions. Therefore $\mathcal{F}_{\text{dress}}$ is non-invertible. □

5 Operational Hypothesis

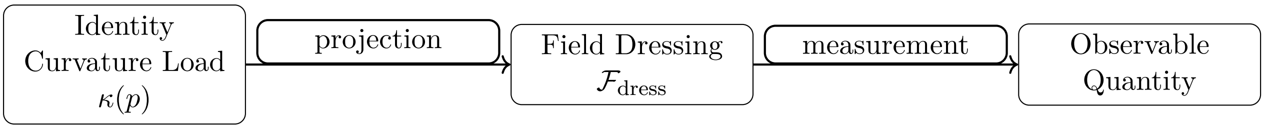
A representative operational form is

$$m_{\mathrm{obs}}(l, Z) \approx \kappa(p_l)\, A\, e^{\beta \Delta R_Z} + \chi_{\mathrm{wk}}(Z),$$

where A and β are system constants.

Remark 3. *This expression is not claimed as final. It specifies the structural dependencies required for projection, not a fitted empirical law.*

6 Projection Diagram



7 Implications

Field dressing resolves several long-standing issues:

- Apparent mass hierarchy inflation
- Non-proportional scaling of identity indices
- Observable asymmetry without intrinsic parameter inflation
- Compatibility with renormalization without continuum primacy

This reframes renormalization as structural projection rather than correction.

8 Conclusion

Observable physical quantities are projections of discrete structural identities, not direct reflections of them. Field dressing is therefore a necessary and unavoidable component of any theory that begins from discrete admissible structure. With this paper, the Control–Structure Series is complete.

Glossary

- **Curvature Load (κ)**: Discrete identity-scale structural demand.
- **Field Dressing**: Non-linear projection from identity to observables.
- **PAL**: Phase Alignment Lock constraint.
- **Observable**: Measured quantity after projection.
- **Non-invertible**: Many-to-one mapping under projection.

Document Timestamp and Provenance

This document is part of Pattern Field Theory (PFT) and the Allen Orbital Lattice (AOL). It completes the Control–Structure Series and defines the projection layer required for observable correspondence.