Explicit Falsifiable Predictions from Discrete Transport Structure

Empirical Consequences of the Allen Orbital Lattice Framework

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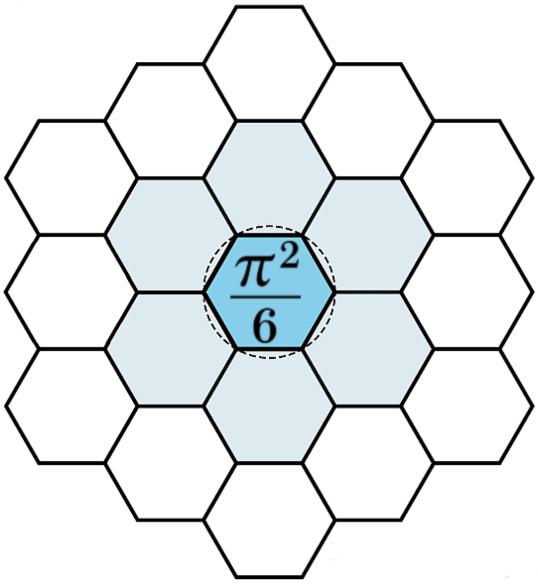

Abstract

A set of quantitative empirical predictions is derived from a discrete transport framework in which physical propagation occurs on a hexagonal adjacency lattice with bounded update rate. Closure stabilization, oscillatory confinement, and diffusion limited coherence produce measurable structural consequences across interaction cross section scaling, radiation coherence, propagation anisotropy, and spectral suppression. Each prediction is formulated with an explicit falsification criterion.

Discrete Propagation Structure

Transport occurs in finite steps of length a with update time τ.

Propagation bound:

$$\sigma = \frac{a}{\tau}$$

Finite step transport produces nonzero lattice scale corrections at sufficiently high energy or resolution.

Prediction 1 — Energy Dependent Propagation Dispersion

Prediction 1. *Propagation speed approaches the transport bound asymptotically but exhibits higher order corrections at wavelengths approaching the lattice scale.*

Effective dispersion relation:

$$v(k) = \sigma \left(1 - \beta(ka)^2 + \mathcal{O}((ka)^4)\right)$$

where k is wavenumber and β is a structural constant of order unity.

Observable

Energy dependent arrival time differences in ultra high energy photon propagation.

Measurement

Gamma ray burst timing comparisons across energy bands.

Falsification

No measurable deviation from constant propagation speed at arbitrarily high energy resolution.

Prediction 2 — Directional Micro Anisotropy

Hexagonal adjacency introduces discrete rotational symmetry.

Prediction 2. *At extremely small scales, propagation exhibits weak directional anisotropy aligned with lattice symmetry axes.*

Angular modulation amplitude:

$$\Delta v(\theta) \propto (a/\lambda)^2 \cos(6\theta)$$

Observable

Orientation dependent phase velocity in precision interferometry.

Measurement

Rotational cavity experiments or high precision interferometric phase comparisons.

Falsification

No orientation dependent signal within resolution limits.

Prediction 3 — Quantized Closure Spectrum

Closure stabilization occurs at discrete radii.

Prediction 3. *Stable confinement structures exhibit preferred scale ratios determined by integer closure cycles.*

Closure spectrum:

$$r_n = n r_0$$

Observable

Discrete preferred resonance scales in confined systems.

Measurement

Precision spectroscopy of confined oscillatory systems.

Falsification

Continuously distributed resonance spectrum without clustering.

Prediction 4 — Modified Thomson Scattering at Extreme Confinement

Interaction cross section depends on closure confinement.

Prediction 4. *At extreme energy density where closure radius approaches transport scale, scattering cross section deviates from classical value.*

Correction scaling:

$$\sigma = \sigma_T \left(1 + \gamma (a/r_c)^2\right)$$

Observable

High energy scattering experiments.

Measurement

Electron photon scattering at ultra high field intensity.

Falsification

Exact classical cross section independent of confinement scale.

Prediction 5 — Diffusion Limited Coherence Cutoff Structure

Transport diffusion produces finite coherence horizon.

Prediction 5. *Radiation spectra exhibit exponential suppression above a scale determined by geometric mean of transport step and closure radius.*

$$\lambda_D = \sqrt{\frac{ar_c}{6}}$$

Observable

Specific scaling relation between damping length and interaction horizon.

Measurement

High precision Cosmic Microwave Background damping tail analysis.

Falsification

Damping scale unrelated to transport derived scaling.

Operational Test of Prediction 5 Using CMB Damping Spectra

The following procedure converts the theoretical scaling of Prediction 5 into a directly measurable estimator.

This section states an explicit observational test for the discrete-transport damping scale derived from Allen Orbital Lattice (AOL) transport primitives. The derivation uses only: lattice step length a, update interval τ, rendering ceiling $\sigma \equiv a/\tau$, closure radius r_c, and the resulting diffusion coefficient D and damping length λ_D.

Transport diffusion and damping length

For randomized transport on the 2D AOL adjacency, the diffusion coefficient is

$$D \;=\; \frac{a^2}{6\tau} \;=\; \frac{a\sigma}{6}, \tag{1}$$

and Fourier mode amplitudes satisfy exponential decay

$$A_k(t) \;=\; A_k(0)\,\exp\Big(-Dk^2t\Big)\,. \tag{2}$$

Using the closure-radius identification $r_c \equiv \sigma/\omega_c$ (closure confinement scale), the associated transport damping length is

$$\boxed{\lambda_D = \sqrt{\frac{a\,r_c}{6}}} \tag{3}$$

This relation is the discrete-transport damping scale that must be observed in any radiation spectrum governed by AOL transport, including the Cosmic Microwave Background damping tail (Prediction 5).

Observable definition from CMB high-ℓ spectra

High-multipole CMB power spectra exhibit an exponential suppression envelope (the damping tail). Define an empirical damping multipole ℓ_D by fitting the high-ℓ envelope with a Gaussian diffusion form

$$\mathcal{E}(\ell) \;\propto\; \exp\!\left[-\left(\frac{\ell}{\ell_D}\right)^2\right], \tag{4}$$

or equivalently define an observed damping wavenumber k_D by the mapping

$$k \;\approx\; \frac{\ell}{D_A}, \qquad k_D \;\approx\; \frac{\ell_D}{D_A}, \tag{5}$$

where D_A is the comoving angular-diameter distance to last scattering used in the same spectrum fit. The corresponding observed comoving damping length is then

$$\boxed{\lambda_D^{\rm obs} \equiv \frac{1}{k_D} \approx \frac{D_A}{\ell_D}} \tag{6}$$

Prediction 5 as a falsifiable constraint

Prediction 5 is the equality between the observed damping length and the discrete-transport damping length,

$$\boxed{\lambda_D^{\rm obs} = \sqrt{\frac{a\, r_c}{6}}} \tag{7}$$

Equivalently, the CMB damping tail fixes the product ar_c:

$$\boxed{a\, r_c = 6\left(\lambda_D^{\rm obs}\right)^2 \approx 6\left(\frac{D_A}{\ell_D}\right)^2} \tag{8}$$

Consistency gate across independent estimators

The test is strengthened by requiring that the ar_c value inferred from the CMB damping tail is consistent with a and r_c inferred from independent discrete-transport predictions (e.g. dispersion constraints, anisotropy constraints, and closure spectrum constraints). Define

$$\boxed{\begin{aligned} \hat{\lambda}_D &= \sqrt{\frac{a\, r_c}{6}} \\ \lambda_D^{\rm obs} &= \frac{D_A}{\ell_D} \end{aligned}} \tag{9}$$

$$\boxed{\left|\hat{\lambda}_D - \lambda_D^{\rm obs}\right| > \Delta\lambda_D} \tag{10}$$

If this inequality is satisfied, Prediction 5 is falsified.

This constitutes a parameter-constrained empirical test with no free adjustable scale.

Here $\Delta\lambda_D$ is the combined uncertainty from the damping-tail fit (for ℓ_D) and from the independent determinations of a and r_c.

Minimal statement

The CMB damping tail provides a direct empirical anchor for discrete transport:

$$\lambda_D^{\rm obs} \;\approx\; \frac{D_A}{\ell_D} \;\overset{\rm PFT}{=}\; \sqrt{\frac{a\, r_c}{6}}. \tag{11}$$

This is a parameter-tight, quantitative test because the same a and r_c appear in the broader discrete-transport hierarchy and may be constrained by additional, independent observations.

No free parameters are introduced in this test beyond those appearing independently in discrete transport dynamics.

Prediction 6 — Discrete Noise Floor in Vacuum Fluctuations

Finite update transport produces minimal stochastic phase variation.

Prediction 6. *Vacuum fluctuation spectrum exhibits high frequency cutoff determined by update interval.*

Cutoff frequency:

$$\omega_{max} \sim \frac{1}{\tau}$$

Observable

Sharp ultraviolet spectral suppression.

Measurement

Casimir force deviation at extremely small separation.

Falsification

Unbounded fluctuation spectrum.

Prediction 7 — Lorentz Invariance Breakdown Scale

Lorentz symmetry emerges as continuum limit.

Prediction 7. *Lorentz invariance weakly breaks at scale approaching transport step.*

Deviation parameter:

$$\delta_L \sim (a/\lambda)^2$$

Observable

Energy dependent invariant interval deformation.

Measurement

Ultra high energy particle propagation.

Falsification

Exact Lorentz invariance at all scales.

Experimental Accessibility

Observable domains:

- ultra high energy astrophysics
- precision interferometry
- quantum confinement spectroscopy
- high intensity scattering
- cosmological radiation structure
- vacuum fluctuation measurement

Summary

The discrete transport framework predicts measurable deviations from continuum physical models in propagation, interaction geometry, coherence structure, and relativistic symmetry at sufficiently small scale or high energy.

Failure to observe these deviations falsifies the discrete transport substrate hypothesis.

References

- Planck Collaboration (2018). CMB power spectrum
- Jackson (1999). Classical Electrodynamics
- Amelino-Camelia (2002). Quantum gravity phenomenology

Document Timestamp and Provenance

This document is an original research publication within Pattern Field Theory (PFT) and the Allen Orbital Lattice (AOL) framework, authored by James Johan Sebastian Allen. It defines discrete transport structure, quantitative prediction relations, and operational empirical test procedures including estimator construction, parameter inference, and falsification criteria.

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