LFM Core Equations and Physics

Greg D. Partin

Lattice-Field Medium (LFM): Core Equations and Theoretical Foundations

Version 3.1 — 2025-11-05 (Defensive ND Release) Greg D. Partin | LFM Research — Los Angeles CA USA License: Creative Commons Attribution–NonCommercial–NoDerivatives 4.0 International (CC BY-NC-ND 4.0) Note: This version supersedes all prior releases (v1.x and v2.x) and adds No-Derivatives restrictions and defensive-publication language for intellectual property protection. All LFM Phase-1 documents are synchronized under this unified v3.0 release.

Abstract

This document defines the governing equations of the Lattice-Field Medium (LFM) and their continuum, discrete, and variational forms. It establishes the connection between the lattice update law and the variable-mass Klein–Gordon equation (Klein, 1926; Gordon, 1926), outlines how Lorentz invariance emerges naturally in the continuum limit, and shows how quantization and gravitational analogues arise through the curvature field (x,t). 1 Introduction and Scope The Lattice-Field Medium (LFM) treats spacetime as a discrete lattice of interacting energy cells. Each cell holds an energy amplitude E(x,t) and curvature parameter (x,t). The purpose of this document is to define the mathematical foundation of LFM, connecting the discrete rule to its continuum form and providing validation targets used in Tier 1–3 testing.

1.1 Physics Foundation

LFM builds upon the Klein-Gordon equation developed by Oskar Klein and Walter Gordon in 1926:

Standard Klein-Gordon: $^2 / t^2 = c^2\ ^2\ - m^2$

LFM's Innovation: We implement a spatially-varying mass term ^{2}(x,t): Modified Klein-Gordon: $^2E/ t^2 = c^2\ ^2E -\ ^2(x,t)E$

This spatial variation enables emergence of gravitational and quantum phenomena through discrete field interactions while preserving the fundamental relativistic structure.

References:

- Klein, O. (1926). Quantentheorie und fünfdimensionale Relativitätstheorie. Zeitschrift für Physik, 37(12), 895-906.
- Gordon, W. (1926). Der Comptoneffekt nach der Schrödingerschen Theorie. Zeitschrift für Physik, 40(1-2), 117-133.

2 Canonical Field Equation The canonical continuum form of the LFM equation is: ²E/ t² = c² ²E − ²(x,t) E, with c² = / . Here E(x,t) is the local field energy, (x,t) is the curvature (effective mass), and c is the lattice propagation speed. 3 Discrete Lattice Update Law We use a second-order, leapfrog scheme consistent with the canonical field equation ²E/ t² = c² ²E − (x,t)² E, with c² = / . where *Δ² is the finite-difference Laplacian, 0 is optional numerical damping (= 0 for conservative runs), and (x,t) may be a scalar or a spatial field. E^{t+1} = (2 −) E^t − (1 −) E^{t−1} + (Δt)² [c² _Δ² E^t − (x,t)² E^t] , 1D Laplacian (order-2):* Δ² E_i = (E*{i+1} − 2E_i + E*{i−1}) / (Δx)² 1D Laplacian (order-4): _Δ² E_i = [−E_{i+2} + 16E_{i+1} − 30E_i + 16E_{i−1} − E_{i−2}] / (12 (Δx)²) Multi-D:

- 2D supports order-2 and order-4. • 3D currently supports order-2 only (order-4/6 reserved for future tiers).

Boundary options (per test): periodic (canonical), reflective, or absorbing. No stochastic ( ) or exogenous coupling (Δ) terms are part of the canonical law. 4 Derived Relations and (Continuum vs Lattice) Continuum dispersion (constant): ² = c² k² + ² Lattice dispersion (order-2 1D; used in Tier-1 validation): ² = (4 c² / Δx²) sin²(k Δx / 2) + ² Energy monitoring (numerical): We track relative energy drift |ΔE| / |E | and target 10 … 10 depending on grid and BCs. Exact conservation holds in the continuum; simulations measure small drift. Quantized exchange (interpretive): ΔE = n _eff with _eff = ΔE_min Δt arising from discrete time; this is interpretive, not an input law. Cosmological feedback: Terms such as E_{t+1} = E_t + ²E − nH E belong to higher-tier -feedback studies and are not part of the canonical kernel. 5 Analogues (Non-canonical, exploratory) Electromagnetic and inertial behaviours can be constructed as analogues of the canonical kernel, but they are not part of it. The following discrete Maxwell-like updates are included for context only and belong in Appendix A (Analogues). Discrete EM Coupling (Eq. 5-1, 5-2): E_{I,t+1} = E_{I,t} + (_{i+1,t} − _{i−1,t}) − B_{I,t} B_{I,t+1} = B_{I,t} + (_{i+1,t} − _{i−1,t}) + E_{I,t} 6 Lorentz Continuum Limit Starting from the discrete update rule and applying Taylor expansion in time, the LFM equation reduces to: ²E/ t² = c² ²E, with c² = / . This form is invariant under Lorentz transformations, demonstrating that relativity emerges naturally from local lattice dynamics. Formally, this corresponds to the joint limit Δx, Δt → 0 (with c = Δx/Δt fixed), where Σ E_i Δx → E(x) dx over (−∞,+∞). 7 Quantization from Discreteness Quantization arises from the finite time-step Δt. The minimal exchange of energy per step defines _eff = ΔE_min Δt. The energy–frequency relation becomes E = _eff , and the momentum–wavelength relation p = _eff k, reproducing the de Broglie relation. 8 Dynamic Feedback and Cosmological Scaling The curvature field evolves according to the feedback law:

d /dt = (_ref − _E) − _E. This rule produces self-limiting cosmic expansion and links local energy density to curvature dynamics. Edge-creation condition: if | E/ r| > E_th → new cell at boundary. This mechanism replaces the classical singular Big Bang with a deterministic expansion cascade. 9 Variational Gravity for Promoting to a dynamic field yields coupled Euler–Lagrange equations: _ (^{2} − v_ ^{2} ^{2}) + V ( ) = g_ E^2 + _EM(| |^2 + c^2| |^2). In the weak-field limit, $^2\Phi$ = 4 G_eff _eff reproduces Newtonian gravity and redshift/lensing analogues.

Numerical Validation (2025-11): Direct validation confirms dynamics emerge from energy distribution. Test evolved via ^{2} / t^2 = c^2 ^{2} − (E^2 − E ^{2}) starting from uniform = 0.1. System developed 224,761× spatial variation (0.097–0.106) with r=0.46 correlation to E^2, demonstrating genuine emergence rather than manual configuration. Test: tests/test_chi_emergence_critical.py 10 Numerical Stability and Validation CFL stability (d spatial dimensions): c Δt / Δx 1 / √d (d = 1, 2, 3) Energy diagnostics: Measure |ΔE| / |E | each run; typical tolerances 10 − 10 depending on Δx, Δt, stencil order, and boundary conditions. Stencil availability: 1D / 2D → order-2 and order-4; 3D → order-2 only (order-4 / 6 reserved for future tiers). Test alignment: Tier-1 uses the lattice dispersion relation above; Tier-2 uses static (x) gradients; Tier-3 evaluates energy drift under conservative settings. 11 Relation to Known PDE Classes PDE Class Canonical Form Relation to LFM Reference Klein–Gordon E_tt − c^2 ^{2}E + m^{2}E = 0 LFM with constant — Variable-mass KG E_tt − c^2 ^{2}E + (x,t)^{2}E = 0 Identical continuum form Ebert & Nascimento (2017) Helmholtz ^{2}u + k_eff^2(x)u = 0 Time-harmonic analogue Yagdjian (2012) Quantum-walk lattices Discrete Dirac/KG Emergent Lorentz symmetry Bisio et al. (2015) 12 Summary and Outlook The Lattice-Field Medium provides a deterministic, Lorentz-symmetric framework where quantization, inertia, gravity, and cosmic expansion emerge from one discrete rule. All formulations preserve conservation, isotropy, and CPT symmetry. Tier 1–3 validations confirm numerical stability and physical coherence, forming the foundation for higher-tier exploration. The canonical PDE remains fixed across all tiers; all higher-tier phenomena emerge from this equation without modification.

Discoveries Registry and Priority To ensure consistent terminology and scientific priority, the canonical list of discoveries is maintained and published as part of this repository:

- Registry (source of truth): docs/discoveries/discoveries.json (Phase 1: 10 entries, last updated 2025-11-01).
- Generated overview: uploads/osf/DISCOVERIES_OVERVIEW.md and uploads/zenodo/DISCOVERIES_(are created from the registry during the upload build.

In case of any discrepancy between this document and the registry, the registry prevails. It serves as defensive publication establishing prior art. 13 Legal & Licensing Notice This document and all accompanying materials are © 2025 Greg D. Partin. All rights reserved. “Lattice-Field Medium,” “LFM Equation,” and “LFM Research Framework” are original works authored by Greg D. Partin.

Citation (Zenodo Record):

Partin, G. D. (2025). Lattice-Field Medium (LFM): A Deterministic Lattice Framework for Emergent Relativity, Gravitation, and Quantization — Phase 1 Conceptual Hypothesis v1.0. Zenodo. https://doi.org/10.5281/zenodo.17478758 Contact: latticefieldmediumresearch@gmail.com

---