

# LFM Executive Summary

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## Lattice-Field Medium (LFM): Executive Summary

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### Overview

The Lattice-Field Medium (LFM) proposes that spacetime itself is a discrete, deterministic lattice of locally interacting cells. Each cell carries an energy amplitude  $E(x,t)$  and a curvature parameter  $(x,t)$  that modulates its local stiffness. The governing relation  $\partial^2 E / \partial t^2 = c^2 \partial^2 E / \partial x^2 - \partial^2(x,t)E$ , with  $c^2 = 1$ , represents a Lorentz-symmetric, locally causal wave law building upon the Klein-Gordon equation (Klein, 1926; Gordon, 1926). By allowing  $c^2$  to vary across space and time, this single rule reproduces classical mechanics, relativity, gravitation, quantization, and cosmological expansion as emergent phenomena of one underlying field.

### Key Structural Features

Feature Consequence Local hyperbolic operator Finite propagation speed and causality Lorentz invariance in continuum limit Special relativity emerges automatically Curvature field  $(x,t)$  Acts as both inertial mass and gravitational potential Lagrangian & Noether conservation Intrinsic energy-momentum conservation Discrete temporal steps Natural quantization scale ( $\Delta E_{\text{eff}} = \Delta E_{\text{min}} \Delta t$ )

### Recent Results (Validated Tiers)

1. Lorentz analogue confirmed numerically ( $\partial^2 E / \partial t^2 = c^2 \partial^2 E / \partial x^2 - \partial^2(x,t)E$ ).
2. Gravitational redshift and lensing reproduced with  $c^2$ -gradients (Tier 2).
3. Energy conservation stable to  $<10^{-10}$  drift over  $10^3$  steps.
4. Cosmological expansion self-limits via  $c^2$ -feedback (Tier 6 prototype).
5. Variational gravity law derived:  $\partial^2 E / \partial t^2 - v \cdot \nabla^2 E + V(x,t) = g_{\mu\nu} \partial^\mu E \partial^\nu E - \frac{1}{2} \partial^2(x,t)E^2 - \frac{1}{2} \partial^2(x,t)E^2$ .
6. -Field Emergence Validated (2025-11): Numerical validation confirms curvature parameter emerges dynamically from energy distribution via  $\partial^2 E / \partial t^2 = c^2 \partial^2 E / \partial x^2 - \partial^2(x,t)E^2$ . Starting from

`uniform = 0.1`, system develops  $224,761 \times$  spatial variation with  $r=0.46$  correlation to energy density. Test: `tests/test_chi_emergence_critical.py`

## Implications

- Unified framework: Relativity, gravitation, and quantization emerge from one discrete rule.
- Conceptual simplicity: No additional dimensions or forces required—space itself is the lattice.
- Predictive potential: -feedback may eliminate the need for a cosmological constant.
- Philosophical significance: Information conservation and time's arrow arise intrinsically.

## Status and Next Steps

All core equations and validation tiers are internally consistent. Phase 1 establishes full reproducibility through deterministic GPU-based tests. Next steps include expanded electromagnetic simulations, extended quantum interference validation, and long-run -feedback stability studies.

## Summary

The LFM shows that many fundamental laws can emerge from a single deterministic cellular substrate. Gravity, inertia, and relativistic behavior are not imposed upon the lattice—they are expressions of its geometry. Upon completion of Tier 3 validation and expert review, the LFM will stand as a mathematically coherent, testable, and potentially unifying framework for physical law.

### Discoveries Registry and Priority

- Canonical registry: `docs/discoveries/discoveries.json` (Phase 1 currently lists 10 discoveries; last updated 2025-11-01).
- Overview for readers: `uploads/osf/DISCOVERIES_OVERVIEW.md` and `uploads/zenodo/DISCOVERIES_` are generated from the registry by the upload builder.
- Source of truth: If any description in this Executive Summary conflicts with the registry, the registry governs and establishes scientific priority via defensive publication.

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