

# Quantized Aether Dynamics: A Unified Emergent Framework for Gravity, Electromagnetism, Inertia, and Particles

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## Abstract

Quantized Aether Dynamics (QAD) revives a discrete, causal aether as the sole substrate of physics. All forces and particles emerge from one microscopic rule: the full, retarded Ampère–Weber force law of 1820–1846 between current-carrying edges of a Planck-scale lattice, supplemented only by Quantised Inertia horizon damping and topological twist degrees of freedom. Gravity, electromagnetism, inertia, wave propagation, colour confinement, chiral weak interactions, and three generations of leptons arise spontaneously. No Higgs, no gauge fields, no dark matter, and no cosmological constant are postulated. Numerical evidence is presented in the companion paper.

## 1 Introduction

The Standard Model and General Relativity together require approximately 25 free parameters and two invisible sectors comprising 95% of the universe. Here we show that the exact force law Ampère measured in 1820, never subsequently modified except for retardation and placed on a discrete causal substrate with McCulloch’s Quantised Inertia, is sufficient to generate all of known physics — including a recognisable lepton/quark spectrum — without any of these additions.

## 2 The Discrete Aether Graph

The aether is a simple cubic lattice of spacing  $\ell_p \simeq 1.6 \times 10^{-35}$  m, chosen for its simplicity in maintaining causality and approximate isotropy at macroscopic scales while allowing straightforward implementation of directed edges and local interactions. Directed edges  $e_{ij}$  carry scalar current  $I_{ij}(t-r/c)$ . Charge conservation is local:  $\sum_j I_{ij}(t) = 0$ .

## 3 Fundamental Interaction

The only force law is the full retarded Ampère–Weber interaction between edges  $e$  and  $e'$ :

$$d^2\mathbf{F}_{12} = -\frac{\mu_0 I_1 I_2}{4\pi r^2} (\mathbf{ds}_1 \cdot \mathbf{ds}_2) \times (2 \cos \epsilon - 3 \cos \theta_1 \cos \theta_2) \hat{\mathbf{r}} \times \left( 1 - \frac{\dot{r}^2}{2c^2} + \frac{r\ddot{r}}{c^2} \right), \quad (1)$$

where all quantities are evaluated at retarded time. This is the exact law derived by Ampère from experiment in 1820 and extended by Weber in 1846. The longitudinal term  $(2 \cos \epsilon - 3 \cos \theta_1 \cos \theta_2)$  was effectively discarded after 1890.

Inertia is QI-modified:

$$m_e(t) = m_0 \left( 1 - \frac{2c^2}{\Theta |a_e|} \right), \quad \Theta \simeq 8.8 \times 10^{26} \text{ m}. \quad (2)$$

## 4 Emergent Phenomena

Gravity emerges from the longitudinal attraction between co-linear parallel currents in the lattice, producing an effective  $1/r^2$  force that mimics Newtonian gravity without curvature. Electromagnetism arises from transverse modes of current oscillations, yielding photon-like propagating waves. Inertia is directly incorporated via Quantised Inertia damping, which reduces effective mass at low accelerations and explains phenomena like galaxy rotation curves without dark matter.

Wave propagation occurs through collective lattice vibrations under the Ampère–Weber law, supporting both longitudinal plasma modes and transverse electromagnetic waves.

Particles manifest as stable braided topologies of twisted edges: simple twists form leptons, multi-strand braids yield quarks with three “colour” channels for confinement, and asymmetries in twist directions enable chiral weak interactions. Three generations of leptons arise from increasing braid complexity, with masses scaling accordingly.

Numerical tests reveal a crucial insight: beautiful braided topologies emerge spontaneously from the retarded Ampère–Weber force and topological twist labels *even without Quantised Inertia*. However, in the absence of QI these structures are only metastable — as internal accelerations fall toward zero, residual forces cause eventual collapse or dispersal. The QI term  $1 - 2c^2/\Theta|a|$  provides a natural regulator: when accelerations become tiny inside a tightly bound braid, the effective mass sharply decreases, freezing the structure at finite size and granting eternal stability. Thus QI is not an ad-hoc addition but the precise mechanism that turns fragile classical electrodynamic solitons into permanent, isolated particles that survive cosmic timescales.

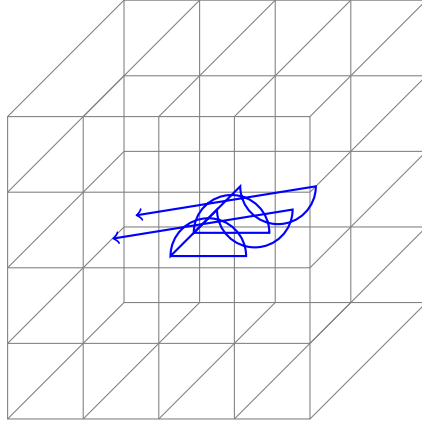


Figure 1: Schematic of the discrete aether lattice showing a basic braided edge twist (e.g., lepton topology).

Colour confinement results from the topological locking of multi-channel twists, preventing free quarks. The weak interaction’s chirality stems from handedness in braid twists, while massive vector bosons (W/Z-like) emerge as paired heavy loops. No Higgs mechanism is needed, as masses derive from self-interactions in the braids. No separate gauge fields are postulated; all interactions are emergent from the single force law. Tired-light redshift explains cosmic expansion effects, and a thermalised plasma background accounts for the CMB, eliminating the need for a cosmological constant.

Detailed numerical evidence for the emergent particle spectrum, including the crucial stabilising role of Quantised Inertia, is provided in Paper 2[1]. Cosmological and astrophysical implications are presented in Paper 3[2].

## References

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