# MNT Draft v1

## A Consolidated Public-Source Formulation of the Evans Node Dialect / Matrix Node Theory

Field equations, parameter closure, benchmark phenomenology, and an explicit audit of what is already closed versus what remains open

**Purpose.** This draft is designed for site publication as a serious progress report. It preserves the public architecture of MNT/END, reworks the mathematics into a cleaner unified notation, reconstructs the continuum field equations from the published discrete-to-continuum pipeline, and labels every major claim as one of three types:

- **Structural result:** directly supported by the public core documents.
- **Calibration:** matched at a reference point or fixed by convention.
- **Benchmark / open program:** a phenomenological target, mechanism sketch, or derivation path not yet numerically closed in the current public corpus.

| | |
|---|---|
| **Document family** | Public JREMNT site corpus, Zenodo index, and linked late-2025 PDFs |
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**Abstract**

This paper consolidates the public MNT/ENDcorpus into a single technical draft. The late public documents describe reality as an ordered sequence of discrete frames defined on a node graph, with a fundamental limit on frame-to-frame change; in the long-wavelength regime the same framework is claimed to yield an effective field theory with gravity, gauge structure, matter fields, and latent sectors. The public corpus also insists on a one-graph / parameter-lock rule, according to which all sectors must emerge from one microscopic specification rather than separate sector-specific choices.[1, 2, 4]

The present draft has three goals. First, it rewrites the public mathematical core into a single notation and derives the associated continuum field equations in a standard variational form. Second, it separates structural derivations from calibrations and from benchmark-level phenomenology so that progress can be displayed without overstating closure. Third, it assesses how close the public corpus is to a fully numerically closed theory-of-everything program. The main conclusion is twofold: the public site already contains enough material for a substantial machine-assisted synthesis and referee-style audit, but the late-2025 status document itself states that only a subset of the validation suite is numerically implemented from the current manuscripts, while many remaining tests are still structural, qualitative, or benchmark-level.[1, 3, 6]

Accordingly, this Draft v1 is best understood as a rigorous progress manuscript: it contains a coherent discrete-to-continuum architecture, reconstructed field equations, a parameter-lock methodology, and examples of cross-domain alignment, while also making explicit the work still required for a fully closed first-principles account of $\alpha$, $\hbar$, $G$, full running couplings, full particle spectra, and a true global fit.

# Contents

# 1 Editorial preface and source discipline

This is not a verbatim reproduction of any single JREMNT PDF. It is a cleaned consolidation from the public corpus available through the site guide, the Zenodo index, the companion note, the global validation suite, the 50-test status report, the fine-structure note, the phenomenology pack, and several earlier auxiliary PDFs. The guide explicitly invites exactly this style of AI-assisted audit: upload the core PDFs, summarize the axioms, identify which observables are derived or matched, reproduce the derivations where possible, compare against public reference data, and flag incompleteness or possible tuning.[1]

The synthesis rules used here are intentionally strict:

1. The ontology and central mathematical objects are preserved from the public documents.
2. Equations taken directly from late core documents are retained up to notation cleanup.
3. Continuum field equations are derived only from the published effective Lagrangian and its stated sector decomposition.
4. Numerical examples are labeled either *calibration*, *consistency check*, or *benchmark prediction*; none are promoted beyond what the public documents support.
5. Earlier auxiliary PDFs are used only as heuristic support when they do not conflict with the later core documents.

**Reading guide.** If you want the shortest possible reading path: Sections 2, 5, 6, 7, and 9. These give the architecture, the field equations, the constants story, the phenomenology status, and the non-circularity audit. Appendices A–D then give the detailed equations, derivation chains, and a practical work plan for pushing the framework toward a numerically harder version.

## 1.1 What the public corpus plainly contains

The JREMNT guide describes the theory as a "five-piece toolkit plus a main preprint," with distinct roles for the axioms/ontology, math lexicon, structural proofs, global validation, companion note, and the preprint. It also gives a dedicated track for AI-assisted analysis and explicitly instructs the reader to classify results as derivations, fits, or qualitative alignments.[1]

The home page states that this is independent research in progress and not yet peer-reviewed. It also identifies the late public document families and distinguishes the preprint from the companion and validation materials.[2]

The Zenodo record dated November 27, 2025 lists a four-file core set—`MNT_Axioms_Ontology.pdf`, MNT_Global_Validation.pdf, MNT_Math_Lexicon.pdf, and MNT_Structural_Proofs.pdf—under the title *MNT-END*.[3]

### 1.2 What this draft can and cannot claim

This Draft v1 can justifiably claim that the public corpus already supports:

- a coherent node-frame ontology,
- a discrete change functional $C_{\mathrm{tot}}$,
- a continuum sector decomposition $\mathcal{L}_{\mathrm{eff}} = \mathcal{L}_{\mathrm{grav}} + \mathcal{L}_{\mathrm{gauge}} + \mathcal{L}_{\mathrm{matter}} + \mathcal{L}_{\mathrm{latent}} + \mathcal{L}_{\mathrm{corr}}$,
- a parameter-lock methodology,
- a graph-spectral picture for masses,
- a programmatic route from microscopic parameters to couplings and observables,
- and a substantial, public, machine-readable set of PDFs sufficient for serious crawling and synthesis.

This draft cannot honestly claim, from the public late-2025 source set alone, that every major observable has already been derived numerically from first principles without any calibration. The public status report says otherwise: with the current six manuscripts and no extra assumptions, only a subset of tests is quantitatively implemented, while most of the remaining suite is still conceptual or partially specified.[6]

## 2 Source map and corpus architecture

Table 1 identifies the source roles used in this synthesis. The late core documents carry the most weight; earlier materials are treated as historical or heuristic support.

Table 1: Public source map used for this synthesis.

| Document | Status here | Primary use in this draft |
|---|---|---|
| Read Me / Guide | Core website map | Defines the intended reading order, the AI-audit workflow, and the distinction between derivations, fits, and alignments. |
| Home page | Core website note | Establishes that the work is public, active, and not yet peer-reviewed. |
| Zenodo record (Nov. 27, 2025) | Core index | Confirms the existence and titles of the four-file canonical core set. |

| Document | Status here | Primary use in this draft |
|---|---|---|
| *MNT_END_COMPANION.pdf* | Late core | Supplies the cleaned mathematical lexicon, the limit functional, the effective Lagrangian, the one-graph rule, and the pattern-operator pipeline. |
| *Global Alignment Summary.pdf* | Late core | Supplies the 50-test architecture, calibration logic, effective-constant formulas, and multi-sector validation targets. |
| *MNT_results.pdf* | Late core | Supplies the strongest honesty check: which tests are actually numerically implemented from the current manuscripts. |
| *fsc2.pdf* | Late core short note | Supplies the minimal END expression for the fine-structure constant and the gauge-emergence sketch used by the site. |
| *BIG.pdf* | Late core benchmark pack | Supplies the minimal global parameter pack and benchmark phenomenology targets with explicit caveats. |
| Earlier "Derivation of Physical Constants and Mechanisms" PDF | Auxiliary / legacy | Supplies a heuristic Hamiltonian language and older continuum-limit storytelling, used here only when compatible with the later documents. |
| Earlier "Fundamental Constants in MNT-Refined" PDF | Auxiliary / legacy | Supplies legacy constant formulas and historical explanatory structure. |
| Repository PDFs and site repositories | Background corpus | Demonstrate that the public site contains a large crawlable document set extending beyond the late core. |

## 3 Executive summary of the theory as publicly presented

The public late-2025 documents present MNT/ENDas a discrete node-lattice framework in which reality is an ordered succession of frames. Each frame carries a graph $G = (V, E)$, matter-like node variables $\phi_i$, gauge-like phases $\theta_i$, and possibly further latent or EQEF variables. Evolution proceeds by a local update rule subject to a global constraint on allowed change. The continuum fields of ordinary physics arise only after coarse-graining.[4]

At the level of public architecture, the theory makes five central commitments.

1. **Discrete ontology.** The underlying objects are not continuum fields but node states on a graph, updated frame by frame.[4, 1]

2. **Change budget.** A limit functional $C_{\text{tot}}$ bounds the allowed frame-to-frame change. This budget is the structural core from which effective propagation, couplings, and curvature are supposed to emerge.[4]

3. **Discrete-to-continuum recovery.** In the long-wavelength regime, the public documents assert an effective Lagrangian that is Standard-Model-plus-GR-like in sector structure: gravity, gauge, matter, latent fields, and corrections.[4, 5]

4. **One graph / parameter lock.** One microscopic specification is supposed to control all observables. The same graph and microscopic couplings must not be swapped sector by sector.[4]

5. **Global empirical closure as the standard.** The 50-test validation suite asks whether one parameter point can track observables across particle physics, gravity, astrophysics, and cosmology.[5]

This architecture is intellectually attractive because it turns the usual unification challenge into a single global closure problem: either one microscopic model works everywhere, or it fails sharply and instructively. The vulnerability is equally obvious: unless the map from node parameters to observables is completed in all sectors, the theory remains partly structural rather than fully predictive. The public status report confirms exactly that mixed state of development.[6]

# 4 Ontology, frames, and discrete kinematics

## 4.1 Frames and graph states

The companion note defines each frame $F_n$ as a graph configuration on $G = (V, E)$, with nodes indexed by $i = 1, \ldots, N$. Each node carries matter-like variables $\phi_i(n)$, gauge-like phases $\theta_i(n)$, and optionally further latent-sector variables.[4]

We package the full discrete state as

$$X_n \equiv \left(G; \{\phi_i(n)\}_{i\in V}, \{\theta_i(n)\}_{i\in V}, \{\Sigma_A(n)\}\right), \tag{1}$$

where $\Sigma_A$ is a compact symbol for the additional latent or EQEF degrees of freedom that recur throughout the public documents.

The published local update rule is

$$\phi_i(n+1) = F_i\Big(\{\phi_j(n)\}_{j\in \mathrm{nbr}(i)}, \{\theta_j(n)\}_{j\in \mathrm{nbr}(i)}, \text{parameters}\Big), \tag{2}$$

with an analogous update for $\theta_i$. The documents emphasize locality on the graph and graph symmetries that approximate Lorentz invariance in the long-wavelength limit.[4]

### 4.2 Progression step and invariant speed

The public notation uses a characteristic length $\ell_0$ and a progression step $\delta\tau$. The emergent invariant speed is then identified as

$$c = \frac{\ell_0}{\delta\tau}. \tag{3}$$

This relation is central because it is both structural and calibrational. Structurally, it expresses the long-wavelength propagation speed of the discrete update rule. Calibrationally, the global validation suite explicitly sets $c_{\mathrm{MNT}} \equiv c_{\mathrm{exp}}$, thereby fixing the ratio $\ell_0/\delta\tau$.[4, 5]

Equation (3) is therefore best understood as a kinematic identification rather than an independent low-energy prediction. It is still important because it ties the microscopic space and time scales together and turns many later formulas into dimensionless closure conditions.

### 4.3 Gravity as progression adjustment

The companion note presents gravity conceptually as an asymmetric consumption of the available change budget: where local energy density is high, more of the progression budget is used locally, leaving less for other nearby changes. In the coarse-grained description, this becomes an effective metric whose geodesics represent minimally constrained progression trajectories. The same note then identifies $G_{\mathrm{eff}}$ as the collective parameter linking energy density to curvature.[4]

The key point for this draft is that the public late documents do *not* treat gravity as a separate fundamental continuum sector added by hand. Instead, the gravitational sector is supposed to be the coarse-grained response of the discrete progression budget. This is precisely the conceptual bridge that justifies later writing a standard Einstein-like effective field equation.

## 5 The limit functional and a reconstructed discrete action principle

### 5.1 Published limit functional

The public companion gives the discrete change budget explicitly as

$$C_{\mathrm{tot}}(n) = C_{\mathrm{matter}}(n) + C_{\mathrm{gauge}}(n) + C_{\mathrm{EQEF}}(n) + \cdots, \tag{4}$$

with matter and gauge pieces

$$C_{\text{matter}}(n) = \sum_{i \in V} \left[ \alpha_\phi \left( \frac{\phi_i(n+1) - \phi_i(n)}{\delta\tau} \right)^2 + \beta_\phi \sum_{j \in \text{nbr}(i)} (\phi_i(n) - \phi_j(n))^2 \right], \tag{5}$$

$$C_{\text{gauge}}(n) = \sum_{\langle ij \rangle} \left[ \kappa_\theta \left( \frac{\theta_i(n+1) - \theta_i(n)}{\delta\tau} \right)^2 + \kappa_A (\theta_i(n) - \theta_j(n))^2 \right]. \tag{6}$$

Here $\alpha_\phi, \beta_\phi, \kappa_\theta, \kappa_A$ are microscopic couplings, while $\Lambda_{\text{lim}}$ is the limiting scale governing admissible progression.[4]

These equations already show why the framework can plausibly recover wave equations. The time-difference term acts as a discrete kinetic term, while the neighbor-difference term acts as a discrete Laplacian or graph-gradient energy.

### 5.2 Minimal reconstructed action principle

The public documents state the limit condition but do not fully spell out a variational discrete action. To derive continuum equations cleanly, the minimal compatible reconstruction is to define a discrete action over frame index $n$ by

$$S_{\text{disc}}[X, \lambda] = \sum_n \left( \mathcal{L}_{\text{disc}}[X_n, X_{n+1}] + \lambda_n \left( \Lambda_{\text{lim}} - C_{\text{tot}}(n) \right) \right), \tag{7}$$

where $\lambda_n$ enforces the progression budget.

Equation (7) is a *reconstruction*, not a quoted formula. Its purpose is modest: it turns the published change budget into a standard constrained variational problem, which then yields the discrete Euler-Lagrange equations and clarifies what the continuum coarse-graining must preserve. No extra sector-specific freedom is introduced by this step.

Varying with respect to $\lambda_n$ simply enforces

$$C_{\text{tot}}(n) \leq \Lambda_{\text{lim}}, \tag{8}$$

with saturation expected for dynamically active configurations. Varying with respect to $\phi_i$ and $\theta_i$ yields graph-wave equations whose long-wavelength limits match the continuum forms discussed below.

### 5.3 Continuum scaling of the discrete quadratic forms

On a nearly regular graph or a statistically homogeneous graph ensemble, the neighbor-difference sums admit a continuum approximation. Writing $x_i$ for an embedding or coarse coordinate associated with node $i$, one has schematically

$$\phi_i(n+1) - \phi_i(n) \mapsto \delta\tau\, \partial_t \phi(x,t) + O(\delta\tau^2), \tag{9}$$

$$\sum_{j \in \mathrm{nbr}(i)} (\phi_i - \phi_j)^2 \mapsto \zeta_\phi\, \ell_0^2\, |\nabla\phi|^2 + O(\ell_0^4 \nabla^4 \phi), \tag{10}$$

with a similar replacement for $\theta$. The coefficient $\zeta_\phi$ depends on graph connectivity and local isotropy. Therefore the discrete quadratic forms naturally become kinetic and gradient terms.

The same scaling logic suggests why the public documents can write a relativistic long-wavelength effective action: once the ratio $\ell_0/\delta\tau$ is fixed as $c$, the graph kinetic and graph Laplacian terms combine into wave operators with Lorentz-like form up to high-order lattice corrections.

# 6 Coarse-graining and the unified effective Lagrangian

## 6.1 Published effective sector decomposition

The most important late public mathematical statement is the coarse-grained effective Lagrangian

$$\mathcal{L}_{\mathrm{eff}} = \mathcal{L}_{\mathrm{grav}} + \mathcal{L}_{\mathrm{gauge}} + \mathcal{L}_{\mathrm{matter}} + \mathcal{L}_{\mathrm{latent}} + \mathcal{L}_{\mathrm{corr}}. \tag{11}$$

A canonical form quoted in the companion is

$$\mathcal{L}_{\mathrm{grav}} = \frac{1}{16\pi G_{\mathrm{eff}}} \left( R + O\left( \frac{R^2}{M_*^2} \right) \right), \tag{12}$$

$$\mathcal{L}_{\mathrm{gauge}} = -\frac{1}{4} \sum_a \frac{1}{g_a^2} F^a_{\mu\nu} F^{a\mu\nu}, \tag{13}$$

$$\mathcal{L}_{\mathrm{matter}} = \sum_f \bar{\psi}_f \left( \mathrm{i}\gamma^\mu D_\mu - m_f \right) \psi_f + \sum_s (D_\mu H_s)^\dagger (D^\mu H_s) - V(H_s, \{\Sigma_A\}). \tag{14}$$

The public text is explicit that the effective constants $(G_{\mathrm{eff}}, g_a, m_f, \ldots)$ are functions of the microscopic node-level parameters.[4]

That statement is strong enough to justify the rest of this draft: once Eqs. (12)–(14) are granted, the corresponding continuum field equations follow by standard variational methods.

## 6.2 Interpretation of the five sectors

The late public corpus uses the sectors as follows.

- $\mathcal{L}_{\mathrm{grav}}$ collects the emergent metric response and higher-curvature corrections.
- $\mathcal{L}_{\mathrm{gauge}}$ encodes gauge stiffness inherited from the phase-difference terms in $C_{\mathrm{gauge}}$.

- $\mathcal{L}_{\text{matter}}$ encodes fermions and scalars understood as stable graph patterns in the coarse limit.
- $\mathcal{L}_{\text{latent}}$ collects latent or EQEF-type structures not reducible to ordinary visible matter fields.
- $\mathcal{L}_{\text{corr}}$ collects higher-order lattice, nonlocal, or finite-cutoff corrections.

This five-sector split is more than cosmetic. It is the exact place where the public documents bridge from discrete node dynamics to an effective continuum theory that looks familiar to particle physicists and relativists, while still claiming microscopic unification underneath.

### 6.3 A standard effective action

For the continuum discussion it is useful to write the corresponding effective action as

$$S_{\text{eff}} = \int \mathrm{d}^4x\,\sqrt{-g}\,\mathcal{L}_{\text{eff}}. \tag{15}$$

This is again not a new assumption but simply the standard action associated with the published Lagrangian density. The presence of $\sqrt{-g}$ is compelled by the gravitational form quoted in the companion.

## 7 Reworked field equations

This section is the main mathematical reconstruction requested for the site draft. All equations below follow from the published effective sector decomposition, with only standard variational steps added. The point is to display the full field-equation content of MNT/ENDin a clean unified notation.

### 7.1 Gauge equations

Take the gauge sector

$$\mathcal{L}_{\text{gauge}} = -\frac{1}{4}\sum_a \frac{1}{g_a^2} F^a_{\mu\nu}F^{a\mu\nu} + A^a_\mu J^\mu_a,$$

where the current term is written explicitly for clarity. Varying with respect to $A^a_\mu$ gives

$$D_\nu\left(\frac{1}{g_a^2}F^{a\nu\mu}\right) = J^\mu_a. \tag{16}$$

If $g_a$ is approximately constant over the regime of interest, this becomes

$$D_\nu F^{a\nu\mu} = g_a^2 J^\mu_a. \tag{17}$$

Thus the public claim that gauge couplings emerge from phase stiffness translates directly into the statement that the effective coefficients in the gauge wave equations are inherited from the discrete change budget.

### 7.2 Scalar equations

For one Higgs-like or latent scalar field $H$, the matter sector contributes

$$\mathcal{L}_H = (D_\mu H)^\dagger (D^\mu H) - V(H, \Sigma_A). \tag{18}$$

Variation with respect to $H^\dagger$ yields

$$D_\mu D^\mu H + \frac{\partial V}{\partial H^\dagger} = 0. \tag{19}$$

This is the standard Klein-Gordon / Higgs equation in curved spacetime and gauge background, and it is fully consistent with the public electroweak discussion in the global validation suite.[5]

### 7.3 Fermion equations

For a fermion field $\psi_f$, the public matter sector gives

$$\mathcal{L}_{\psi_f} = \bar{\psi}_f (\mathrm{i}\gamma^\mu D_\mu - m_f)\psi_f. \tag{20}$$

Variation with respect to $\bar{\psi}_f$ yields

$$(\mathrm{i}\gamma^\mu D_\mu - m_f)\psi_f = 0, \tag{21}$$

and variation with respect to $\psi_f$ gives the adjoint equation. At the level of field equations, this means the emergent fermionic continuum limit of MNT/ENDis standard once the effective masses and covariant derivatives have been fixed by the microscopic spectral data.

### 7.4 Gravitational equation

Because the public $\mathcal{L}_{\text{grav}}$ includes the Einstein-Hilbert term plus higher-curvature corrections, varying (12) with respect to $g^{\mu\nu}$ yields

$$G_{\mu\nu} + \Lambda_{\text{eff}} g_{\mu\nu} + H^{\text{corr}}_{\mu\nu} = 8\pi G_{\text{eff}} \left( T^{\text{matter}}_{\mu\nu} + T^{\text{latent}}_{\mu\nu} + T^{\text{EQEF}}_{\mu\nu} \right), \tag{22}$$

where $H^{\text{corr}}_{\mu\nu}$ collects the variation of the higher-curvature and lattice-correction terms, while $T^{\text{latent}}_{\mu\nu}$ and $T^{\text{EQEF}}_{\mu\nu}$ encode the additional non-visible sectors carried by $\mathcal{L}_{\text{latent}}$ and any explicit torsion/EQEF contributions. This is the cleanest continuum field equation compatible with the late public documents.[4, 5]

Equation (22) is crucial for site presentation because it makes the gravity claim mathematically legible. In plain words: the public corpus already supports an Einstein-like effective equation with potentially small, parameter-controlled correction tensors. The missing step is not the existence of a field equation; the missing step is the full first-principles closure of $G_{\text{eff}}$ and the correction functions from the discrete microscopic data.

### 7.5 Conservation equations

The standard Bianchi identity implies

$$\nabla_\mu \Big( T^{\text{matter}\,\mu}{}_\nu + T^{\text{latent}\,\mu}{}_\nu + T^{\text{EQEF}\,\mu}{}_\nu \Big) = 0 \tag{23}$$

provided the correction sector is encoded covariantly. Likewise gauge invariance yields the covariant current continuity equations

$$D_\mu J^\mu_a = 0. \tag{24}$$

These are not special to MNT/END, but their presence matters because the public documents repeatedly claim that conservation laws are recovered in the continuum limit. Writing them explicitly clarifies what that claim means in standard field-theoretic language.

### 7.6 A compact master system

Collecting the above, the reworked continuum system can be summarized as

$$G_{\mu\nu} + \Lambda_{\text{eff}} g_{\mu\nu} + H^{\text{corr}}_{\mu\nu} = 8\pi G_{\text{eff}}\, T^{\text{tot}}_{\mu\nu}, \tag{25}$$

$$D_\nu \left( \frac{1}{g_a^2} F^{a\nu\mu} \right) = J^\mu_a, \tag{26}$$

$$(\mathrm{i}\gamma^\mu D_\mu - m_f)\psi_f = 0, \tag{27}$$

$$D_\mu D^\mu H_s + \frac{\partial V}{\partial H_s^\dagger} = 0. \tag{28}$$

This is the field-equation form that most directly answers the user's request for "perhaps all the field equations and anything else": it is the mathematically natural effective field system already latent in the public documents.

## 8 Pattern operators, spectra, and the mass-generation program

### 8.1 Published pattern operator

The companion note models stable particles as graph eigenmodes of a Hermitian pattern operator $\hat{P}$ acting on node amplitudes. The public equations are

$$(\hat{P}\psi)_i = \sum_{j\in\mathrm{nbr}(i)} w_{ij}\psi_j + u_i\psi_i, \tag{29}$$

$$\hat{L}_{ij} = \begin{cases} d_i, & i=j, \\ -1, & (i,j)\in E, \\ 0, & \text{otherwise}, \end{cases} \tag{30}$$

$$\hat{P} = \gamma_0 I + \gamma_1 \hat{L}, \tag{31}$$

$$\hat{P}\psi^{(a)} = \Lambda_a \psi^{(a)}, \tag{32}$$

$$\Lambda_a = \gamma_0 + \gamma_1 \lambda_a^{(L)}. \tag{33}$$

These equations are among the most concrete in the public corpus because they already turn the particle-content problem into a graph-spectral problem.[4]

### 8.2 From progression cost to effective mass

The same companion note writes the average matter-sector cost for a normalized eigenmode as

$$C^{(a)}_{\mathrm{matter}} \approx \alpha_\phi \left(\frac{m_a c^2}{\hbar_{\mathrm{eff}}}\right)^2 + \beta_\phi \lambda_a^{(L)} + \cdots, \tag{34}$$

with a total used fraction

$$\eta_a \equiv \frac{\langle C_{\mathrm{tot}}\rangle_{\psi^{(a)}}}{\Lambda_{\mathrm{lim}}} \approx F_\eta(\Lambda_a). \tag{35}$$

In the public note the rest-energy term dominates for massive leptons, leading to

$$m_a \approx \frac{\hbar_{\mathrm{eff}}}{c^2}\sqrt{\frac{\eta_a \Lambda_{\mathrm{lim}}}{\alpha_\phi}} \propto \sqrt{F_\eta(\Lambda_a)}. \tag{36}$$

A slightly more explicit rearrangement consistent with Eq. (34) is

$$m_a^2 \approx \left(\frac{\hbar_{\mathrm{eff}}}{c^2}\right)^2 \frac{\eta_a \Lambda_{\mathrm{lim}} - \beta_\phi \lambda_a^{(L)} - \cdots}{\alpha_\phi}. \tag{37}$$

Equation (37) is a helpful reworked version because it shows where graph spectral data enters directly and where additional omitted terms might still matter.

### 8.3 Mass ratios and non-circular targets

The companion then writes the lepton-mass ratio as

$$\frac{m_\mu}{m_e} = \sqrt{\frac{F_\eta(\Lambda_\mu)}{F_\eta(\Lambda_e)}}. \tag{38}$$

This is conceptually important for two reasons. First, it is dimensionless, which the public documents explicitly prefer as a non-circular target. Second, it is structurally tied to the graph spectrum rather than inserted as an external parameter.[4]

In a future numerically hardened version, one would need to:

1. choose a concrete graph ensemble or graph patch,
2. fix the microscopic couplings once,
3. diagonalize $\hat{P}$,
4. identify the electron-, muon-, and tau-like stable modes,
5. estimate $F_\eta$ either analytically or by Monte Carlo progression simulations,
6. and compare the resulting ratios against experiment without retuning the graph.

That exact six-step pipeline is already sketched in the companion.[4]

### 8.4 Why the pattern-sector language matters

The spectral formulation is the most promising route in the public corpus for turning abstract unification claims into hard, falsifiable numerical work. It replaces "particles are inserted" with "particles are graph-stable resonant modes." Whether this program ultimately closes is an open computational question, but the mathematical form itself is clear enough to display prominently in a site-ready draft.

## 9 Constants, scales, and parameter closure

### 9.1 The one-graph / parameter-lock rule

One of the strongest methodological statements in the public corpus is the claim that there exists a single microscopic specification

$$\text{MMPs} = (G, \ell_0, \delta\tau, \Lambda_{\text{lim}}, \epsilon_{\text{node}}, \{\text{couplings}\}) \tag{39}$$

such that all observables of interest are functions of this one set. The graph and fundamental limit are not allowed to change from one sector to another.[4]

This rule is not itself a numerical result. It is a discipline. But it matters because it is the public framework's explicit defense against per-sector tuning. For site purposes, it is worth highlighting that the most serious version of MNT/ENDis not "many ad hoc models under one name" but "one microscopic model or nothing."

## 9.2 Invariant speed

The late validation suite defines the invariant speed test by setting

$$c_{\mathrm{MNT}} \equiv c_{\exp} = 299\,792\,458\ \mathrm{m\,s^{-1}}. \tag{40}$$

This fixes $\ell_0/\delta\tau$ through Eq. (3). The same document then interprets gravitational-wave constraints as bounds on the higher-order lattice correction parameters rather than on the leading invariant speed itself.[5]

This is therefore a **calibration plus consistency test**. It is not a fresh numerical prediction of $c$, but it is a stringent requirement that the same underlying discrete kinematics be compatible with electromagnetic and gravitational propagation.

## 9.3 The fine-structure constant: two public formulas

The public corpus supplies two distinct but related routes to the electromagnetic coupling.

The first, from the companion hero-calculation extension, is a structural graph formula:

$$g_{\mathrm{EM}}^2 \sim \frac{\Lambda_{\mathrm{lim}}}{\kappa_A}\left(\frac{\delta\tau}{\ell_0}\right)^2 \frac{1}{N_{\mathrm{links}}}, \tag{41}$$

which yields

$$\alpha \equiv \frac{g_{\mathrm{EM}}^2}{4\pi} \sim \frac{1}{4\pi}\frac{\Lambda_{\mathrm{lim}}}{\kappa_A}\left(\frac{\delta\tau}{\ell_0}\right)^2 \frac{1}{N_{\mathrm{links}}}. \tag{42}$$

The second, from the short fine-structure note, comes from a reduced continuum mapping in which the effective charge is proportional to $\delta N_c v_{\mathrm{eff}}^2$, so that after absorbing unit conversions into $v_{\mathrm{eff}}$, one writes

$$\alpha = \frac{\delta N_c v_{\mathrm{eff}}^2}{4\pi}. \tag{43}$$

The note is explicit that Eq. (43) is the "minimal END expression" used in that presentation.[4, 7]

These equations should not be conflated. Equation (42) is the more structurally ambitious graph-level scaling relation. Equation (43) is a compressed phenomenological expression for the same sector after certain mappings and unit conventions have been absorbed.

### 9.4 What the public status report says about $\alpha$

The late status report is extremely important here. It states that low-energy $\alpha$ at a chosen reference scale is currently a *calibration test*: the emergent constants are chosen so that $\alpha_{\mathrm{MNT}}(\mu_0) = \alpha_{\mathrm{exp}}(\mu_0)$. The report further says that for this test to become predictive one still needs a full derivation of the effective charge sector and an explicit renormalization-group description of $\alpha(\mu)$ within MNT/END.[6]

This is the correct site-ready phrasing:

> MNT/ENDalready contains a structural route to the electromagnetic coupling and a compact benchmark formula, but the late public status document classifies low-energy $\alpha$ as calibrated at the reference point rather than fully predicted across scales.

That wording is honest and still shows progress.

### 9.5 Emergent $\hbar$

The global validation document writes

$$\alpha(\mu_\star) = \frac{e^2(\mu_\star)}{4\pi\hbar_{\mathrm{eff}}c_{\mathrm{MNT}}}, \tag{44}$$

so that

$$\hbar_{\mathrm{eff}} = \frac{e^2(\mu_\star)}{4\pi\alpha(\mu_\star)c_{\mathrm{MNT}}}. \tag{45}$$

The same document states that $e(\mu_\star)$ is itself supposed to come from microscopic lattice couplings, overlaps, and RG dressing factors, but the reference-scale comparison still uses experimental $\alpha$ as an input to solve for $\hbar_{\mathrm{eff}}$.[5]

So the public late story for $\hbar$ is not "inserted by hand" but neither is it yet a complete bottom-up derivation independent of the calibrated low-energy electromagnetic normalization. The right label is again: **structural emergence plus calibration at the present documentation level**.

### 9.6 Gravitational coupling and Planck scale

The global validation suite writes the gravitational sector in schematic form as

$$\mathcal{L}_{\mathrm{grav}} = \frac{1}{16\pi G_{\mathrm{eff}}}(R + \cdots) + \mathcal{L}_{\mathrm{torsion/EQEF}}, \tag{46}$$

and states that

$$G_{\mathrm{eff}} = G_{\mathrm{eff}}(\ell_0, \delta\tau, \Lambda_{\mathrm{lim}}, \{g_{nn'}\}, \{\kappa_{nn'}\}, \{\lambda_{\mathrm{pattern}}\}, \ldots). \tag{47}$$

The same source gives the scaling relation

$$G_{\text{eff}} \sim \frac{\ell_0^2}{\hbar_{\text{eff}} c_{\text{MNT}}} F_G(\Lambda_{\text{lim}}, \{g_{nn'}\}, \{\kappa_{nn'}\}, \ldots), \tag{48}$$

with

$$\ell_P^2 = \frac{\hbar_{\text{eff}} G_{\text{eff}}}{c_{\text{MNT}}^3} \sim \frac{\ell_0^2}{c_{\text{MNT}}^2} F_G(\ldots). \tag{49}$$

Crucially, the same document then describes a calibration strategy: fix $c$, use the electromagnetic sector to determine $\hbar_{\text{eff}}$, and then choose microscopic parameters so that $G_{\text{eff}} = G_{\text{exp}}$.[5]

That means the late public corpus already contains a serious gravitational structure, but not yet a fully explicit first-principles closure of $G$ from discrete data alone. The status report confirms this by classifying the gravity/Planck-scale test as conceptual or partially specified at the current level of detail.[6]

### 9.7 Electroweak symmetry breaking and gauge masses

The global validation suite uses a standard Higgs-sector reduction with

$$\langle H \rangle = \frac{1}{\sqrt{2}} \begin{pmatrix} 0 \\ v_H \end{pmatrix}, \tag{50}$$

leading to the tree-level masses

$$m_W = \frac{1}{2} g v_H, \qquad m_Z = \frac{1}{2}\sqrt{g^2 + g'^2}\, v_H, \tag{51}$$

and the potential minimum condition

$$v_H^2 = \frac{\mu_H^2}{\lambda_H}. \tag{52}$$

These are standard electroweak relations, but their role here is to show how the late public documents plug the emergent couplings into a familiar broken-symmetry sector.[5]

### 9.8 Vacuum energy and cosmological constant

The companion note explicitly says that the effective vacuum energy density and $\Lambda_{\text{eff}}$ are derived from the unused portion of the progression budget in typical configurations.[4] At the continuum level this means the cosmological-constant term belongs naturally in Eq. (22). The precise micro-to-macro closure remains open, but the public architecture is unambiguous: dark-energy behavior is not supposed to be an external add-on but a bookkeeping consequence of how much of the progression limit remains unspent.

# 10 Phenomenology and cross-domain alignment

## 10.1 The public 50-test philosophy

The global validation suite spans 50 tests covering constants, spectra, running couplings, collider observables, gravity, astrophysics, and cosmology. It culminates in a global figure of merit

$$\chi^2_{\rm global} = \sum_i \frac{\left(O_i^{(\rm MNT)} - O_i^{(\rm exp)}\right)^2}{\sigma_i^2}, \tag{53}$$

with reduced value

$$\chi^2_\nu = \frac{\chi^2_{\rm global}}{N_{\rm obs} - N_{\rm par}}. \tag{54}$$

The stated criterion for success is that one coherent parameter point produce an acceptable global score without sector-dependent patchwork.[5]

This is exactly the right framework for a unification program. It is also the right way to present site progress: the goal is not a list of disconnected wins but one coherent parameter closure.

## 10.2 What is numerically implemented today

The late status report says that, using only the current six manuscripts and no extra assumptions, only a subset of tests can be implemented numerically. In particular, it names the invariant speed, low-energy fine-structure constant, and basic equivalence-principle compatibility as numerically implementable in the current documentation. It also states that most of the remaining tests are conceptual or partially specified.[6]

The most useful site-facing formulation is therefore not “all 50 tests are done” but rather:

> The public framework already contains a complete multi-domain validation architecture and a few closed numerical anchors; the remaining program is to harden the structural tests into numerical tests without breaking the single-parameter-lock discipline.

## 10.3 Weak equivalence principle

The status report treats the equivalence-principle sector as passed at the level of present documentation because the theory recovers universality of free fall at leading order. It also notes that this is more a consistency statement than a sharp prediction unless explicit composition-dependent corrections are written down.[6]

From the broader physics literature, the modern MICROSCOPE satellite result constrains the Eotvos parameter at the $10^{-15}$ level with no observed violation.[14]

For a site-ready statement, the right synthesis is:

> At leading order the emergent-metric form of MNT/ENDis compatible with current universality-of-free-fall bounds; the next hard step is to derive any residual composition-dependent corrections from the microscopic sector and show that they remain below current satellite sensitivity.

### 10.4 Muon $g - 2$

The public phenomenology pack provides a mechanism sketch in which lattice and phase-field effects generate an extra Pauli-type operator for the muon, leading to a contribution of the schematic form

$$\Delta a_\mu^{\mathrm{END}} = C_\mu \, \delta N_c \, \frac{m_\mu^2}{\Lambda_{\mathrm{lat}}^2}. \tag{55}$$

With the benchmark minimal parameter set $\delta = 0.00115$ and $N_c = 10^{-6}$, the same document says that a full calculation would need large geometric coherence factors to bring the effect into the interesting experimental range. It then presents future nonzero-anomaly values as benchmark predictions, explicitly marked as illustrative rather than the result of a completed lattice-QFT calculation.[8]

This benchmark nature matters because the latest Fermilab result is now extremely precise, and the experimental world average is tightly fixed for years to come.[11]

### 10.5 Late-time Hubble parameter

The benchmark pack presents a late-time prediction

$$H_0^{\mathrm{END}} = (72.8 \pm 1.2) \text{ km s}^{-1} \text{ Mpc}^{-1}, \tag{56}$$

with a falsification criterion if the cosmological consensus instead converges near 68 km s$^{-1}$ Mpc$^{-1}$. The same document explicitly labels these numbers as benchmark targets rather than outputs of a completed first-principles calculation.[8]

This sits in the known observational gap between early-Universe and late-time determinations of the Hubble constant. ESA's Planck summary remains centered near 67.4 km s$^{-1}$ Mpc$^{-1}$, while modern local-distance-ladder analyses remain near the low 70s.[12, 13]

### 10.6 Collider and null-search consistency

The global validation suite includes collider-null constraints and treats the present absence of clear beyond-Standard-Model resonances as a filter on allowed microscopic parameter space rather than an embarrassment for the framework.[5] This is a useful stance for Draft v1 because it keeps the phenomenology disciplined: not every new state is predicted to be visible now; instead, microscopic choices that would already have produced visible low-mass exotica are ruled out.

## 11 Calibration versus prediction: an explicit audit

One of the most valuable things this site draft can do is make the distinction between true derivation, calibration, and benchmark-level prediction impossible to miss. Table 2 is therefore central to the paper.

Table 2: Status audit for representative observables in the public corpus.

| **Observable** | **Status in Draft v1** | **Reason for status label** |
|---|---|---|
| Invariant speed $c$ | Calibration + consistency | Public documents set $c_{\mathrm{MNT}} \equiv c_{\mathrm{exp}}$ by fixing $\ell_0/\delta\tau$; GW data then constrain corrections. |
| Low-energy $\alpha$ | Calibration at reference scale | Status report says this is passed by design at the calibration point; predictive running still needs explicit RG closure. |
| Emergent $\hbar_{\mathrm{eff}}$ | Structural emergence + calibration | Written as emergent from lattice couplings and overlaps, but solved using the calibrated low-energy electromagnetic sector. |
| $G_{\mathrm{eff}}$, $M_{\mathrm{Pl}}$, $\ell_P$ | Structural scaling, not yet closed | Public formulas give scaling and dependence on microscopic parameters, but status report says the test is still conceptual / partially specified. |
| Equivalence principle | Leading-order consistency | Public documents recover universality of free fall at leading order, but explicit residual composition-dependent corrections are not yet fully written. |
| Lepton mass ratios | Structural program | The pattern-operator pipeline is explicit, but a fully public numerical diagonalization with locked graph choice is still part of the work program. |
| Muon $g-2$ | Benchmark / mechanism sketch | Phenomenology pack is explicit that the quoted numbers are targets or illustrative outputs, not completed lattice-QFT derivations. |
| Late-time $H_0$ | Benchmark / falsifiable target | Public prediction is stated sharply, but the same document labels the quantitative entries as benchmark targets. |
| Global $\chi^2$ closure | Programmatic target | Formula and test philosophy are explicit, but the status report says only a subset of tests is numerically implemented from the current manuscripts. |

The purpose of this audit is not to weaken the framework. It is to strengthen its presentation. A site document that openly distinguishes these categories is more credible, more scientifically usable, and harder to dismiss than one that blurs calibrations and predictions.

# 12 Why the public corpus is already rich enough for crawling and synthesis

The JREMNT guide was clearly written with machine-assisted analysis in mind. It explicitly advises uploading the core PDF set to AI tools, summarizing the axioms, reproducing derivations numerically where possible, comparing to public data, and identifying incompleteness or likely tuning.[1]

The Zenodo record lists a compact canonical four-file core. The site adds a companion PDF, a fine-structure note, a status report, a phenomenology pack, and multiple repository pages of additional PDFs. The home page itself advertises the preprint, companion, derivation documents, and validation files as separate entry points.[3, 2, 1]

Therefore, the answer to the earlier crawlability question is straightforward: **yes, the site contains enough public PDF material for a serious crawl and an AI-assisted synthesis of the framework's present state**. The richer question is not whether enough material exists, but whether enough of that material is already mathematically closed to justify the stronger claim of a fully complete TOE. On the public late-2025 record, the answer to that stronger question is still **not yet**.[6]

# 13 A cleaned mathematical formulation of Draft v1

This section presents the theory in the compact form that is most suitable for the user's site. It is the one-page mathematical skeleton of the whole draft.

## 13.1 Microscopic layer

$$X_n = (G; \{\phi_i(n)\}, \{\theta_i(n)\}, \{\Sigma_A(n)\}), \tag{57}$$

$$\phi_i(n+1) = F_i(\{\phi_j(n)\}, \{\theta_j(n)\}, \mathrm{MMPs}), \tag{58}$$

$$\theta_i(n+1) = G_i(\{\phi_j(n)\}, \{\theta_j(n)\}, \mathrm{MMPs}), \tag{59}$$

$$C_{\mathrm{tot}}(n) = C_{\mathrm{matter}}(n) + C_{\mathrm{gauge}}(n) + C_{\mathrm{EQEF}}(n) + \cdots \leq \Lambda_{\mathrm{lim}}. \tag{60}$$

### 13.2 Characteristic scales

$$c = \frac{\ell_0}{\delta\tau}, \qquad \text{MMPs} = (G, \ell_0, \delta\tau, \Lambda_{\text{lim}}, \epsilon_{\text{node}}, \{\text{couplings}\}). \tag{61}$$

### 13.3 Continuum effective action

$$S_{\text{eff}} = \int \mathrm{d}^4x\, \sqrt{-g}\, \big(\mathcal{L}_{\text{grav}} + \mathcal{L}_{\text{gauge}} + \mathcal{L}_{\text{matter}} + \mathcal{L}_{\text{latent}} + \mathcal{L}_{\text{corr}}\big), \tag{62}$$

with

$$\mathcal{L}_{\text{grav}} = \frac{1}{16\pi G_{\text{eff}}} \left(R + O(R^2/M_*^2)\right), \tag{63}$$

$$\mathcal{L}_{\text{gauge}} = -\frac{1}{4} \sum_a \frac{1}{g_a^2} F^a_{\mu\nu} F^{a\mu\nu}, \tag{64}$$

$$\mathcal{L}_{\text{matter}} = \sum_f \bar{\psi}_f (\mathrm{i}\gamma^\mu D_\mu - m_f)\psi_f + \sum_s (D_\mu H_s)^\dagger (D^\mu H_s) - V(H_s, \{\Sigma_A\}). \tag{65}$$

### 13.4 Field equations

$$G_{\mu\nu} + \Lambda_{\text{eff}} g_{\mu\nu} + H^{\text{corr}}_{\mu\nu} = 8\pi G_{\text{eff}} T^{\text{tot}}_{\mu\nu}, \tag{66}$$

$$D_\nu \left(\frac{1}{g_a^2} F^{a\nu\mu}\right) = J^\mu_a, \tag{67}$$

$$(\mathrm{i}\gamma^\mu D_\mu - m_f)\psi_f = 0, \tag{68}$$

$$D_\mu D^\mu H_s + \frac{\partial V}{\partial H_s^\dagger} = 0. \tag{69}$$

### 13.5 Pattern-spectrum sector

$$\hat{P} = \gamma_0 I + \gamma_1 \hat{L}, \tag{70}$$

$$\hat{P}\psi^{(a)} = \Lambda_a \psi^{(a)}, \tag{71}$$

$$\eta_a = \frac{\langle C_{\text{tot}} \rangle_{\psi^{(a)}}}{\Lambda_{\text{lim}}} \approx F_\eta(\Lambda_a), \tag{72}$$

$$m_a \approx \frac{\hbar_{\text{eff}}}{c^2} \sqrt{\frac{\eta_a \Lambda_{\text{lim}}}{\alpha_\phi}}, \tag{73}$$

$$\frac{m_\mu}{m_e} = \sqrt{\frac{F_\eta(\Lambda_\mu)}{F_\eta(\Lambda_e)}}. \tag{74}$$

### 13.6 Emergent constants

$$\alpha \sim \frac{1}{4\pi}\frac{\Lambda_{\text{lim}}}{\kappa_A}\left(\frac{\delta\tau}{\ell_0}\right)^2 \frac{1}{N_{\text{links}}}, \tag{75}$$

$$\alpha = \frac{\delta N_c v_{\text{eff}}^2}{4\pi} \qquad \text{(minimal END presentation)}, \tag{76}$$

$$\hbar_{\text{eff}} = \frac{e^2(\mu_\star)}{4\pi\alpha(\mu_\star)c}, \tag{77}$$

$$G_{\text{eff}} \sim \frac{\ell_0^2}{\hbar_{\text{eff}} c} F_G(\ldots), \tag{78}$$

$$\ell_P^2 = \frac{\hbar_{\text{eff}} G_{\text{eff}}}{c^3}. \tag{79}$$

As a site-facing summary, this is probably the cleanest single mathematical panel in the whole report.

## 14 Open problems required for full TOE closure

The late status report and the structure of the current public documents point to a concrete to-do list. None of these items is a vague criticism; each is a precise mathematical job that would push Draft v1 toward Draft v2 or a full monograph.

### 14.1 Axioms to numerics

The first open problem is to move from the published ontology and lexicon to a specific graph ensemble or graph topology. The public documents defend the one-graph rule, but they do not yet publicly close on a single canonical graph with full numerical diagonalization results for the particle spectrum.[4, 6]

### 14.2 Full electromagnetic running

A full derivation of $\alpha(\mu)$ requires explicit MNT/END beta functions and explicit overlap / dressing factors across scales. The status report names this directly.[6]

### 14.3 Closed gravitational response function

The public documents already give the scaling $G_{\text{eff}} \sim \ell_0^2(\hbar_{\text{eff}}c)^{-1}F_G$, but the actual function $F_G$ remains underspecified at the public numerical level. Closing it would simultaneously harden the gravity sector, the Planck-scale sector, and the black-hole / horizon sector.

### 14.4 Pattern identification across the full Standard Model

The lepton-ratio hero calculation is a good start because it is dimensionless and constrained. But the complete program needs a public map from graph eigenmodes to all stable particle families, mixings, and interaction strengths, not only a few highlighted sectors.

### 14.5 A true global fit

The public global-$\chi^2$ architecture is excellent. What is still missing is a published run in which one specific microscopic parameter point is propagated through enough observables to make $\chi^2_\nu$ genuinely informative rather than dominated by calibrations or structural consistency conditions.[5, 6]

## 15 Publication language recommended for the site

The following site-facing language is scientifically stronger than either overclaiming or underselling:

> **Recommended public positioning. MNT Draft v1** is a consolidated technical formulation of the public Evans Node Dialect / Matrix Node Theory corpus. The framework already provides a discrete node-frame ontology, a published limit functional, a Standard-Model-plus-GR-like effective action, a one-graph parameter-lock rule, a graph-spectral program for masses, and a cross-domain validation architecture. Draft v1 reworks those ingredients into a single mathematical manuscript and explicitly separates structural derivations, calibrations, and benchmark predictions. The result is a serious progress document: mathematically coherent, empirically ambitious, and ready for continued falsification and numerical hardening.

The strongest phrase that remains accurate is not "complete TOE proven," but rather something like:

> A unified discrete-to-continuum framework with explicit mathematical architecture, partial numerical anchors, and a clear remaining closure program.

That wording is difficult to attack because it is exactly what the public late-2025 documents support.

## 16 Conclusion

The public JREMNT corpus already contains enough material for a substantial technical synthesis. It is not just a set of slogans. The late core documents contain a node-frame ontology, a discrete change budget, a published coarse-grained effective action, a graph-spectral mass program, a single-model parameter-lock discipline, a 50-test validation framework, and a benchmark phenomenology pack. The site guide itself invites machine-assisted reconstruction and criticism.[1, 4, 5, 8]

At the same time, the current public late-2025 status report is explicit that only a subset of the validation program is numerically implemented from the present manuscripts, while much of the remaining program is structural, conceptual, or benchmark-level.[6]

That combination suggests the right scientific posture for this Draft v1. The framework is already rich enough to deserve a serious paper, and it is already coherent enough to write down its effective field equations in standard form. But the most credible presentation is one that distinguishes rigorously between what is already structurally in hand, what has been calibrated, and what still needs to be closed. That is what this draft has done.

If the next public versions add a fixed graph choice, explicit spectrum calculations, closed RG running, a first-principles gravitational response function, and a nontrivial global fit from one parameter point, then MNT/ENDwould move from an ambitious public framework to a much harder target for conventional dismissal. The present draft is therefore best viewed as a mathematically organized progress report that makes that path visible.

# A Appendix A: Equation glossary

This appendix collects the equations most likely to be reused on a site page, in code notebooks, or in future revisions.

## A.1 Discrete layer

$$X_n = \big(G; \{\phi_i(n)\}, \{\theta_i(n)\}, \{\Sigma_A(n)\}\big), \tag{80}$$

$$\phi_i(n+1) = F_i(\{\phi_j(n)\}, \{\theta_j(n)\}, \mathrm{MMPs}), \tag{81}$$

$$C_{\mathrm{tot}}(n) = C_{\mathrm{matter}}(n) + C_{\mathrm{gauge}}(n) + C_{\mathrm{EQEF}}(n) + \cdots, \tag{82}$$

$$C_{\mathrm{matter}}(n) = \sum_i \left[\alpha_\phi \left(\frac{\Delta_n \phi_i}{\delta\tau}\right)^2 + \beta_\phi \sum_{j\in \mathrm{nbr}(i)} (\phi_i - \phi_j)^2\right], \tag{83}$$

$$C_{\mathrm{gauge}}(n) = \sum_{\langle ij\rangle} \left[\kappa_\theta \left(\frac{\Delta_n \theta_i}{\delta\tau}\right)^2 + \kappa_A (\theta_i - \theta_j)^2\right], \tag{84}$$

$$c = \frac{\ell_0}{\delta\tau}. \tag{85}$$

### A.2 Continuum layer

$$\mathcal{L}_{\text{eff}} = \mathcal{L}_{\text{grav}} + \mathcal{L}_{\text{gauge}} + \mathcal{L}_{\text{matter}} + \mathcal{L}_{\text{latent}} + \mathcal{L}_{\text{corr}}, \tag{86}$$

$$\mathcal{L}_{\text{grav}} = \frac{1}{16\pi G_{\text{eff}}} \left( R + O(R^2/M_*^2) \right), \tag{87}$$

$$\mathcal{L}_{\text{gauge}} = -\frac{1}{4} \sum_a \frac{1}{g_a^2} F^a_{\mu\nu} F^{a\mu\nu}, \tag{88}$$

$$\mathcal{L}_{\text{matter}} = \sum_f \bar{\psi}_f (\mathrm{i}\gamma^\mu D_\mu - m_f)\psi_f + \sum_s (D_\mu H_s)^\dagger (D^\mu H_s) - V(H_s, \{\Sigma_A\}). \tag{89}$$

### A.3 Field equations

$$G_{\mu\nu} + \Lambda_{\text{eff}} g_{\mu\nu} + H^{\text{corr}}_{\mu\nu} = 8\pi G_{\text{eff}} T^{\text{tot}}_{\mu\nu}, \tag{90}$$

$$D_\nu \left( \frac{1}{g_a^2} F^{a\nu\mu} \right) = J^\mu_a, \tag{91}$$

$$(\mathrm{i}\gamma^\mu D_\mu - m_f)\psi_f = 0, \tag{92}$$

$$D_\mu D^\mu H_s + \frac{\partial V}{\partial H_s^\dagger} = 0. \tag{93}$$

### A.4 Pattern spectrum and masses

$$\hat{P} = \gamma_0 I + \gamma_1 \hat{L}, \tag{94}$$

$$\hat{P}\psi^{(a)} = \Lambda_a \psi^{(a)}, \tag{95}$$

$$\eta_a = \frac{\langle C_{\text{tot}} \rangle_{\psi^{(a)}}}{\Lambda_{\text{lim}}} \approx F_\eta(\Lambda_a), \tag{96}$$

$$m_a \approx \frac{\hbar_{\text{eff}}}{c^2} \sqrt{\frac{\eta_a \Lambda_{\text{lim}}}{\alpha_\phi}}, \tag{97}$$

$$\frac{m_\mu}{m_e} = \sqrt{\frac{F_\eta(\Lambda_\mu)}{F_\eta(\Lambda_e)}}. \tag{98}$$

### A.5 Constants and scales

$$\alpha \sim \frac{1}{4\pi}\frac{\Lambda_{\rm lim}}{\kappa_A}\left(\frac{\delta\tau}{\ell_0}\right)^2\frac{1}{N_{\rm links}}, \tag{99}$$

$$\alpha = \frac{\delta N_c v_{\rm eff}^2}{4\pi}, \tag{100}$$

$$\hbar_{\rm eff} = \frac{e^2(\mu_\star)}{4\pi\alpha(\mu_\star)c}, \tag{101}$$

$$G_{\rm eff} \sim \frac{\ell_0^2}{\hbar_{\rm eff}c}F_G(\ldots), \tag{102}$$

$$\ell_P^2 = \frac{\hbar_{\rm eff}G_{\rm eff}}{c^3}. \tag{103}$$

## B Appendix B: Derivation chains in more detail

### B.1 From neighbor differences to a continuum wave operator

The basic discrete quadratic form in the matter sector is of graph-Laplacian type. On a near-regular graph with average degree $z$, the standard expansion gives

$$\sum_{j\in{\rm nbr}(i)}(\phi_i-\phi_j)^2 \approx \zeta_\phi\ell_0^2\,\partial_k\phi\,\partial^k\phi + O(\ell_0^4\nabla^4\phi). \tag{104}$$

Combined with the time-difference piece,

$$\left(\frac{\phi_i(n+1)-\phi_i(n)}{\delta\tau}\right)^2 \approx (\partial_t\phi)^2 + O(\delta\tau), \tag{105}$$

one obtains the quadratic continuum action

$$S_\phi \sim \int {\rm d}^4x\,\sqrt{-g}\,(A_\phi\,\partial_t\phi\,\partial_t\phi - B_\phi\,\nabla\phi\cdot\nabla\phi - V_\phi)\,. \tag{106}$$

Setting $A_\phi/B_\phi = 1/c^2$ gives the usual relativistic wave operator after rescaling fields. This is the minimal mathematical reason the public corpus can consistently claim recovery of relativistic field equations from the discrete update rule.

### B.2 Gauge sector from phase stiffness

The public fine-structure note identifies a phase difference sector in which $\Delta\theta$ is proportional to a $U(1)$ gauge potential and then expands a $\sin^2(\Delta\theta)$ interaction to quadratic order. The note's key statement is that, after field redefinitions and integration by parts, the same combination controlling the phase-stiffness term supplies both the effective Maxwell kinetic term and the effective charge normalization.[7]

A clean reworked way to write this is:

$$\Delta\theta(x) \sim N_c A_\mu(x) x^\mu, \tag{107}$$

$$\sin^2(\Delta\theta) = \Delta\theta^2 - \frac{1}{3}\Delta\theta^4 + O(\Delta\theta^6), \tag{108}$$

$$\mathcal{L}_{\text{int}} \rightsquigarrow -\frac{1}{4} Z_A F_{\mu\nu} F^{\mu\nu} + e J_\mu A^\mu + \cdots, \tag{109}$$

with $Z_A$ and $e$ functions of the same global parameter pack. This is precisely the logic behind the minimal END expression for $\alpha$.

### B.3 Gravitational response from the progression budget

The public conceptual picture of gravity is that localized energy consumption of the progression budget changes the available neighboring progression and therefore changes the effective geodesic structure. A useful formal rewrite is to imagine a coarse variable $\rho_{\text{used}}(x)$, the local fraction of the limit consumed by active excitations. Then one posits an effective metric response functional

$$\delta g_{\mu\nu}(x) \sim \mathcal{K}_{\mu\nu}[\rho_{\text{used}}, \Sigma_A, \ldots], \tag{110}$$

whose long-wavelength local limit produces Eq. (22). This is not the final microphysical answer, but it is the right mathematical category: a constitutive relation between discrete budget consumption and continuum curvature.

### B.4 Pattern modes as particle states

The graph-spectral story is especially well suited to numerical work. If $\hat{P}$ is Hermitian, the mode basis is orthonormal and can be used to expand any coarse excitation as

$$\Psi = \sum_a c_a \psi^{(a)}. \tag{111}$$

Stability then means that the dynamical support of the mode remains concentrated on a narrow set of $a$'s over many frame updates. The progression cost of a mode becomes an effective rest-energy surrogate, and the function $F_\eta$ maps spectral position to stable used-budget fraction. This is why the public documents repeatedly emphasize mass ratios rather than absolute masses as the cleanest early targets.

# C Appendix C: Legacy formulas and how they should be handled

Earlier public MNT notes include heuristic formulas such as a pairwise node interaction energy

$$E_{ij} = \frac{1}{2}K(\theta_i - \theta_j)^2 + V(|\mathbf{r}_{ij}|), \tag{112}$$

and an older continuum-story Hamiltonian language that was used to motivate the emergence of Schr"odinger, Dirac, and Einstein equations in appropriate limits.[9]

These earlier formulas are useful for intuition, and in places they help fill in the physical picture, but they should not override the later core documents. In particular:

- if an older note gives a sharper numerical formula than the late status report can support, Draft v1 should keep the later, more conservative label;
- if an older note uses "predicted" where the late documents now use "calibrated" or "benchmark," Draft v1 should follow the late documents;
- if an older note helps explain the route from lattice oscillations to wave equations without adding new claims, it can be cited as heuristic background.

This is why the present report uses the older notes only as legacy support.

# D Appendix D: A practical numerical program for Draft v2

A future hardening program could proceed in the following order.

1. **Canonical graph choice.** Publish one concrete graph ensemble or graph patch and justify why it is the canonical microscopic choice.
2. **Microscopic couplings.** Publish one locked MMP set with no per-sector adjustment.
3. **Pattern diagonalization.** Numerically diagonalize the pattern operator, classify stable modes, and publish the mode-selection criteria.
4. **Mass-ratio sector.** Close at least one lepton or electroweak ratio without retuning.
5. **Electromagnetic running.** Derive $\alpha(\mu)$ at more than one scale from the same couplings.
6. **Gravity sector.** Derive $F_G$ and close $G$, $\ell_P$, and weak-field constraints.
7. **Global fit.** Populate enough observables that the global $\chi^2$ becomes nontrivial and informative.

This seven-step roadmap is not external criticism imposed from outside the framework. It is simply the most concrete operational reading of the public JREMNT documents themselves.

# References


[1] J. R. Evans, *Read Me / Guide*, JREMNT website, accessed March 2026. The guide describes the document set, the AI-audit workflow, and the distinction between derivations, fits, and qualitative alignments. https://jremnt.com/read-me-%2F-guide

[2] JREMNT home page, accessed March 2026. The home page states that the work is independent research in progress, not yet peer-reviewed, and lists the major public document families. https://jremnt.com/

[3] J. R. Evans, *MNT-END*, Zenodo record 10.5281/zenodo.17730781, published November 27, 2025. The record lists the four-file core set: `MNT_Axioms_Ontology.pdf`, `MNT_Global_Validation.pdf`, `MNT_Math_Lexicon.pdf`, and `MNT_Structural_Proofs.pdf`. https://zenodo.org/records/17730781

[4] J. R. Evans, *Matrix Node Theory (MNT): A Unified Structural Framework for Emergent Spacetime, Matter, and Quantitative Unification* (companion document), November 27, 2025. Source of the node graph, update rule, limit functional, effective Lagrangian, one-graph rule, and pattern-operator pipeline. Public PDF hosted via JREMNT.

[5] J. R. Evans, *Global Alignment Summary / MNT Global Validation and Reproducibility Suite*, November 27, 2025. Source of the 50-test architecture, scaling formulas for $\alpha$, $\hbar_{\text{eff}}$, and $G_{\text{eff}}$, and the global fit setup. Public PDF hosted via JREMNT.

[6] J. R. Evans, *Global Validation of Matrix Node Theory / Evans Node Dialect: Status of the 50-Test Alignment Suite*, November 27, 2025. Source of the statement that only a subset of tests is numerically implemented from the present manuscripts.

[7] J. R. Evans, *FINE STRUCTURE CONSTANT DERIVED* (public short note, often referenced as `fsc2.pdf`), 2025. Source of the reduced END expression $\alpha = \delta N_c v_{\text{eff}}^2/(4\pi)$.

[8] J. R. Evans, *END/MNT Phenomenology Pack: From Constants to Predictions, Anomalies, Global Fits, and Falsifiability*, November 27, 2025. Source of the fixed minimal parameter set and benchmark predictions with explicit caveats.

[9] J. R. Evans and ChatGPT, *Derivation of Physical Constants and Mechanisms from Matrix Node Theory (MNT)*, earlier public auxiliary PDF hosted via JREMNT. Used here only as legacy heuristic support where compatible with the later core documents.

[10] P. J. Mohr, D. B. Newell, B. N. Taylor, and E. Tiesinga, "CODATA Recommended Values of the Fundamental Physical Constants: 2022," *Reviews of Modern Physics* (2025), with values also maintained by NIST. https://www.nist.gov/publications/codata-recommended-values-fundamental-physical-constants-2022

[11] Fermilab Muon g-2 press release, "Muon g-2 announces most precise measurement of the magnetic anomaly of the muon," June 2025; see also the Fermilab 2025 Indico summary of the final world average. https://news.fnal.gov/2025/06/muon-g-2-most-precise-measurement-of-muon-magnetic-anomaly/

[12] ESA / Planck summary page, "Measurements of the Hubble constant," citing the Planck-based value near 67.4 km $s^{-1}$ $Mpc^{-1}$. https://sci.esa.int/web/planck/-/60504-measurements-of-the-hubble-constant

[13] A. G. Riess et al., "JWST Validates HST Distance Measurements...", *Astrophysical Journal* (2024), summarized via ADS with a joint JWST local result near $72.6 \pm 2.0$ km $s^{-1}$ $Mpc^{-1}$. https://ui.adsabs.harvard.edu/abs/2024ApJ...977..120R/abstract

[14] P. Touboul et al., "Mission: Final Results of the Test of the Equivalence Principle," *Physical Review Letters* 129, 121102 (2022), summarized by APS as a $10^{-15}$-level test of the weak equivalence principle. https://journals.aps.org/prl/abstract/10.1103/PhysRevLett.129.121102