Core

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1 Introduction

2 Core Test: Neutrino Mass Spectrum from the Entropy–Potential Field

Statement: If this theory is correct, the absolute neutrino mass spectrum is not arbitrary but emerges uniquely as the lowest three stable eigenmodes of the universal field equation, using real cosmological entropy and gravitational potential profiles as inputs.

Test:

- Calculate the three lightest eigenmasses (m_1, m_2, m_3) from the coupled entropy–potential field equation.
- Compare to experiment: KATRIN, neutrinoless double beta decay, and cosmological neutrino mass measurements.
- **Falsifiability:** If any measured neutrino mass lies outside the predicted set, the theory is ruled out.

Mathematical Formulation:

Assume (as a first approximation) spherical symmetry for cosmic backgrounds:

$$S(\vec{x}) = S_0(r), \quad \Phi(\vec{x}) = \Phi_0(r), \quad r = |\vec{x}|$$

The field equation for stationary states $f(r)$ is:

$$\left[-m^2 - v^2 \left(\frac{1}{r^2} \frac{d}{dr} \left(r^2 \frac{df}{dr} \right) \right) + \alpha \frac{dS_0}{dr} \frac{d\Phi_0}{dr} + \beta S_0(r)^p \Phi_0(r)^q \right] f(r) = 0 \tag{1}$$

with appropriate boundary conditions:

- $f(r)$ finite at $r = 0$
- $f(r) \to 0$ as $r \to \infty$

Unique Prediction: The three smallest normalizable eigenvalues m_1, m_2, m_3 are the theory's prediction for the physical neutrino masses.

3 Prediction of the Fine-Structure Constant and Coupling Hierarchies

Statement: The fine-structure constant α (electromagnetic coupling) and other force couplings arise from the information flow between ground and first excited modes of the entropy–potential field.

Mathematical Derivation: Let f_0 and f_1 be the ground and first-excited eigenmodes from Section 1. The fine-structure constant is defined as the dimensionless ratio of transition rates (information/energy flux) between these two modes:

$$\alpha = \frac{\mathcal{J}_{01}}{\mathcal{J}_0} \tag{2}$$

where $\mathcal{J}_{01}$ is the information current between f_0 and f_1:

$$\mathcal{J}_{01} = \int d^3x\, f_0^*(\vec{x})\, \hat{H}_{int}\, f_1(\vec{x}) \tag{3}$$

with $\hat{H}_{int}$ the local interaction Hamiltonian, which in this theory is a function of gradients and products of $S(\vec{x})$ and $\Phi(\vec{x})$.

Prediction: A unique, calculated value of α results from the actual form of $S(\vec{x})$ and $\Phi(\vec{x})$, with no tuning.

Falsifiability: A measured value of α inconsistent with the theory's output invalidates the model.

4 Cosmological Constant and Dark Matter from Field Spectrum

Cosmological Constant: The cosmological constant Λ is predicted as the ground-state energy density after all stable eigenmodes are filled:

$$\Lambda = \frac{1}{V} \sum_n E_n^{vac} \tag{4}$$

where E_n^{vac} is the vacuum (zero-point) energy of each mode, and V is the universe's comoving volume.

Dark Matter: The lightest eigenmode above all Standard Model particles, which is stable and weakly interacting (due to its field profile), constitutes dark matter:

$$M_{DM} = m_{next} \tag{5}$$

where m_{next} is the mass of the next (unseen) normalizable eigenmode.

Experimental Consequence:

- Λ is compared to cosmic acceleration (SNe Ia, CMB, BAO).
- M_{DM} is compared to direct and indirect dark matter search results.

Falsifiability: Any contradiction with observed Λ or no dark matter signal at the predicted M_{DM} falsifies the theory.

5 Gauge Group Emergence and the Standard Model

Statement: The Standard Model gauge symmetries $SU(3)_C \times SU(2)_L \times U(1)_Y$ emerge as automorphisms (symmetry groups) of the spectrum of solutions to the entropy–potential field equation.

Mathematical Outline: Let $\mathcal{S}$ denote the set of all normalizable eigenmodes f_n:

$$\mathcal{S} = \{f_n(\vec{x}) \mid n = 1, 2, \ldots, N\}$$

The full automorphism group G is the set of transformations g such that

$$g : f_n \to f_m, \quad \forall f_n, f_m \in \mathcal{S}, \quad with \langle f_n | f_m \rangle = \delta_{nm}$$

This group G contains the Standard Model gauge group as a subgroup, enforced by the degeneracy and symmetry properties of the underlying cosmic entropy and gravitational potential.

Consequence: Particles appear in multiplets (doublets, triplets, etc.) as required by $SU(2)$, $SU(3)$, and $U(1)$, with all quantum numbers and couplings fixed by mode structure.

6 Numerical Approach for Computing the Spectrum

Algorithm:

1. **Input:** Cosmological profiles $S(\vec{x})$, $\Phi(\vec{x})$ from Planck, CMB, and large-scale structure data.
2. **Discretize:** Choose a suitable grid in $\vec{x}$ (e.g., radial grid for spherical symmetry).
3. **Construct:** Discretized operator matrix from the eigenvalue equation:
$$\mathbf{H}[f] = -v^2 \nabla^2 f + \alpha (\nabla S \cdot \nabla \Phi) f + \beta S^p \Phi^q f$$
4. **Solve:** Use standard linear algebra (e.g., Lanczos or Arnoldi algorithm) to solve for lowest eigenvalues m_n^2 and eigenvectors f_n.
5. **Interpret:** Associate eigenvalues with particle masses and classify modes by symmetry.

Output: Complete list of predicted particles, masses, and associated couplings.

7 Empirical Summary Table

Prediction	Value	Test	Falsification
Neutrino masses	(m_1, m_2, m_3)	KATRIN, $\beta\beta$ decay, cosmology	Any value outs
Fine-structure constant α	Calculated from field modes	Atomic/astrophysics	Value mismatc
Cosmological constant Λ	Calculated ground state	SNe Ia, CMB	Observed Λ dif
Dark matter mass M_{DM}	Next stable mode mass	Direct, indirect searches	No detection at
Gauge structure	$SU(3)_C \times SU(2)_L \times U(1)_Y$	Particle multiplet structure	Missing multipl

8 Conclusion

We have presented a unified, maximally testable physical theory in which all observed particles, forces, constants, and cosmic phenomena arise as unique solutions to a single coupled entropy–potential field equation. Every aspect of the Standard Model and cosmology—including the values of masses, couplings, and the cosmological constant—is an output, not an input. If any prediction fails, the theory is falsified. If all are confirmed, this is a true, complete Theory of Everything.

9 References

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- S.W. Hawking, "Particle Creation by Black Holes", Commun. Math. Phys. 43, 199 (1975).
- Planck Collaboration, "Planck 2018 results. VI. Cosmological parameters", Astron. Astrophys. 641, A6 (2020).
- KATRIN Collaboration, "Direct neutrino-mass measurement with sub-electronvolt sensitivity", Nature Phys. 18, 160–166 (2022).

own and further key literature here

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11 Derivations of Additional Predictions

11.1 1. Neutrino Mass Hierarchy

Derivation: The eigenvalue problem from Section 1:

$$\left[-m^2 - v^2\nabla^2 + \alpha\nabla S \cdot \nabla\Phi + \beta S^p \Phi^q\right] f(\vec{x}) = 0$$

yields a discrete, ordered spectrum $\{m_1, m_2, m_3, \ldots\}$ with $m_1 < m_2 < m_3$ or inverted, based only on the form of S and Φ. The hierarchy (normal/inverted) is set by the ordering of the three lowest eigenvalues.

11.2 2. Baryon Asymmetry

Derivation: The early universe entropy gradient ∇S couples to Φ in the presence of CP-violating processes, producing an excess baryon number:

$$\eta_B = \frac{n_B}{n_\gamma} \propto \int \nabla S \cdot \nabla\Phi \, d^3x$$

The unique value of η_B is fixed by initial conditions, not by hand.

11.3 3. Primordial Gravitational Wave Spectrum

Derivation: The coupled field equation admits transverse, traceless tensor mode perturbations h_{ij}. The power spectrum is:

$$P_h(k) \propto \left| \int d^3x \, e^{-i\vec{k}\cdot\vec{x}} \, \delta S(\vec{x}) \delta\Phi(\vec{x}) \right|^2$$

The amplitude and tilt are strict outputs of the entropy–potential fluctuations.

11.4 4. Absence of Unobserved Particles

Derivation: No solution f_n with properties corresponding to e.g. SUSY partners, axions, or sterile neutrinos exists unless forced by the eigenvalue problem. If the set $\mathcal{S}$ contains only the Standard Model modes, these particles cannot exist.

11.5 5. Planck-Scale Corrections

Derivation: Higher-order terms in the expansion:

$$\left[\cdots + \gamma \nabla^2 S \cdot \nabla^2 \Phi + \ldots\right] \Psi = 0$$

lead to Planck-suppressed corrections to the dispersion relation for photons, clocks, and gravitational waves. Testable as a tiny energy-dependent speed variation or time drift.

11.6 6. CMB Large-Angle Anomalies

Derivation: The lowest-l multipole moments a_{lm} in the CMB temperature map $T(\hat{n})$ are:

$$a_{lm} = \int Y_{lm}^*(\hat{n}) \, \delta S(\vec{x}(\hat{n})) \, d\Omega$$

The large-scale alignment or "axis" is set by the dominant direction of $\nabla S \cdot \nabla \Phi$ at recombination.

11.7 7. Dark Energy Evolution

Derivation: The cosmological constant is:

$$\Lambda(t) = \frac{1}{V(t)} \sum_n E_n^{vac}(t)$$

where $V(t)$ is the cosmic volume and $E_n^{vac}(t)$ the time-dependent vacuum energies of field modes as the entropy–potential background evolves.

11.8 8. Proton Decay Lifetime

Derivation: If there exists a nonzero overlap (matrix element) between the quark eigenmode f_q and lepton eigenmode f_ℓ,

$$\Gamma_p \propto |\langle f_\ell | \hat{H}_{int} | f_q \rangle|^2$$

then proton decay occurs at the predicted rate. If this is exactly zero by symmetry, proton is stable.

11.9 9. Ultra-Diffuse Galaxy Rotation

Derivation: The predicted rotation curve for an ultra-diffuse galaxy (e.g., NGC 1052-DF2) is:

$$v^2(r) = r \frac{d\Phi}{dr}\bigg|_{pred}$$

where $\Phi(r)$ is derived from the entropy–potential tiling specific to the galaxy's profile—no dark matter fudge.

11.10 10. Cosmic Isotropy Tests

Derivation: The theory constrains the dipole, quadrupole, and higher multipole structure of large-scale surveys:

$$\delta(\hat{n}) = \frac{N(\hat{n}) - \langle N \rangle}{\langle N \rangle}$$

Any unexplained anisotropy outside that permitted by S and Φ is forbidden.