The Dynamic Background Hypothesis v5.0 Beta: A Unified Pre-Geometric Framework for Gravity, Matter, and Structural Mass Hierarchies

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ABSTRACT

We present the Beta version of the Dynamic Background Hypothesis (DBH) v5.0, a unified field framework where spacetime, matter, and all fundamental interactions ($U(1) \times SU(2) \times SU(3)$) are consistently modeled as emergent phenomena within a single relativistic nematic superfluid substrate. This release completes the unification of the mass sector, demonstrating that mass hierarchies and structural constants emerge from first-principles vacuum rheology rather than from free parameters.

Key breakthroughs included in this version:

1. **Mass Hierarchy & Natural Units:** Identification of the **electron** as the natural unit of mass ($M_e \approx 1/\phi$), establishing the *functional zero* of the substrate's energy scale.

2. **Structural Mass Ratios:** Emergence of the **proton–electron ratio (~1836)** as a consequence of geometric extension and confinement rigidity, rather than constituent mass addition.

3. **Law of Vacuum Containment:** Formalization of mass as the **integrated energy debt** required to stabilize topological defects below the substrate's rupture threshold.

4. **Dimensional Evasion Mechanism:** Demonstration that the hadronic scale jump ($\sim 10^3$) arises from a transition in effective stress dimensionality, from **0D (point-like)** to **1D (string-like)** configurations.

5. **Electroweak & Strong Unification:** Derivation of Maxwell's equations, $SU(2)$ weak symmetry via spinor holonomy, and $SU(3)$ color confinement via the rheological "freezing" of the vacuum (Flux Tubes).

6. **Structural Invariants:** Computational validation of a **bare elastic invariant (~79.00)** with sensitivity below **0.13%** under variations of vacuum stiffness (β) and confinement (σ).

This version provides extensive computational validation across multiple physical regimes, establishing the DBH as a self-consistent, predictive, and thermodynamically grounded approach to fundamental physics.

I. THE STABILITY MANIFESTO: A PARADIGM SHIFT

The DBH v5.0 proposes that **the universe does not evolve by forces, but by stability.** Physical laws are the necessary conditions for the equilibrium of a relativistic nematic sustrate.

- **Gravity as Elasticity:** Curvature is the elastic stress of the vacuum attempting to smooth out topological defects.
- **Matter as a Scar:** Fermions are stable topological solitons (scars) that store deformation energy.
- **Mass as Deuda(energy debt):** Mass is the integrated energy investment required to maintain a deformation without crossing the substrate's rupture threshold.

II. THE UNIFIED ACTION: FROM MOND TO CONFINEMENT

The dynamics of the sustrate are governed by the **Action v4**:

$$S = \int d^4x \sqrt{-g} \left[-\frac{1}{2} g^{\mu\nu} \partial_\mu \Psi \partial_\nu \Psi - (\alpha\rho + \beta\rho^2 + \sigma\rho^{3/2}) \right]$$

The $\sigma\rho^{3/2}$ term acts as a universal scaling regulator:

1. **Infrared (IR):** Derives the MOND scale $a_0 \propto (\sigma/\beta)^2$.
2. **Ultraviolet (UV):** Triggers a rheological phase transition that "freezes" the vacuum between defects, creating the **Flux Tubes** responsible for color confinement.

III. UNIFICATION OF FUNDAMENTAL INTERACTIONS

1. **Electromagnetism ($U(1)$):** Consistently reproduced as the vorticity of the vacuum flow. We provide explicit proof of the two transverse polarization states of the photon.
2. **Weak Interaction ($SU(2)$):** Consistently reproduced from the **non-abelian holonomy** of spinors. The braiding of $Q = 1/2$ defects induces internal rotations that satisfy the $SU(2)$ Lie algebra.
3. **Strong Interaction ($SU(3)$):** Derived as a local phase transition. The energy required to separate defects grows linearly with distance, recovering the phenomenology of

gluonic strings.

IV. HOMEOSTATIC COSMOLOGY: THE ETERNAL CYCLE

The DBH v5.0 solves the problem of cosmic heat death through a **Self-Organized Critical (SOC)** ecosystem. The universe reaches a steady state where densities of matter and dark energy remain constant, a process consistent with self-similar scaling laws potentially linked to irrational scaling ratios (including ϕ) characteristic of optimal stability attractors. The energy injection (S) is derived from first-principles **Zero-Point Energy** fluctuations ($S \propto k_P^5$).

V. COMPUTATIONAL VALIDATION SUITE

This version is supported by the following open-source validation scripts:

- `sim_27_1_atractor_electronico.py` : Proof of the $M_e \approx 1/\phi$ basal state.
- `sim_27_5_test_universalidad.py` : Validation of the 79.00 bare elastic invariant.
- `sim_26c_strong_force.py` : Visualization of flux tubes and color confinement.
- `sim_24b_weak_force.py` : Proof of non-abelian spinor holonomy ($SU(2)$).
- `sim_21a_homeostasis.py` : Proof of the stable cosmic attractor.
  The computational validation suite is available at Zenodo Software: [10.5281/zenodo.17800467].

VI. PREDICTIONS AND OBSERVABLE CONSEQUENCES

The following predictions vary in experimental accessibility and timescale.

1. **Thawing Dark Energy:** $w_0 \gtrsim -1$ and $w_a < 0$.
2. **Universal a_0:** The MOND scale is a universal constant linked to vacuum rheology.
3. **Lorentz Violation:** Measurable deviations in gamma-ray velocity at the Planck scale.
4. **Mass Quantization:** Masses emerge as discrete attractors; intermediate mass states are structurally forbidden by the substrate.

VII. FUTURE WORK AND OPEN PROBLEMS

1. **Mass Spectrum Refinement:** Analytical derivation of the exact M_μ/M_e ratio from the coupling of torsional and density modes.

2. **Gauge Dressing Formalization:** Field-theoretic derivation of the $\alpha^{-1} \approx 137$ ratio as a geometric projection of the elastic invariant in 3D.

VIII. REFERENCES

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IX. ACKNOWLEDGMENTS

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