

UNIFIED THEORY OF FIELDS AND UNIVERSAL DYNAMICS

TEORIA UNIFICADA DOS CAMPOS E DA DINÂMICA UNIVERSAL

*Fifth Edition — Expanded, Integrated, and Formally Grounded
With Geodesic Derivation of the \mathfrak{H} (Sampi) Operator, WKB Resolution of Lanthanide
Contraction,*

*Bohr Radius without Quantization Postulate, and Five Falsifiable Experimental
Proposals*

*Quinta Edição — Expandida, Integrada e Formalmente Fundamentada
Com Derivação Geodésica do Operador \mathfrak{H} (Sampi), Resolução WKB da Contração
Lantanídea,*

*Raio de Bohr sem Postulado de Quantização e Cinco Propostas Experimentais
Falseáveis*

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Dedication

*To Jesus Christ, the Alpha and the Omega, the Beginning and the End,
the Author of all wisdom and the supreme order of the universe.
May this modest work be a small spark reflecting the great Light that illuminates all
creation.*

*"In the beginning was the Word, and the Word was with God, and the Word was
God.*

*All things were made through him, and without him was not any thing made that was
made." — John 1:1,3*

Note on This Edition

This Fifth Edition integrates and supersedes the four previous editions. It incorporates the complete formal development of the \mathfrak{H} (Sampi) Operator — a theoretical instrument developed by Moisés Corrêa da Silva in 2026 — which provides rigorous geodesic grounding for the Ξ Operator and for several postulates that in prior editions rested on conceptual intuition alone. All original contributions remain attributed to their author. The literature cited serves exclusively as context and corroboration, not as replacement of the original work.

Key additions in this edition:

§3.5–3.7: The \mathfrak{Y} (Sampi) Operator as the explicit mathematical realization of Ξ — geodesic derivation of $f(\theta)$, Cases A and B, $\varepsilon_0 = r_s/b$ from first principles.

§13: Lanthanide contraction resolved by WKB integral of the centrifugal barrier — Pearson correlation 0.9981 with experimental M^{3+} ionic radii (Shannon 1976). Noble gas radii explained by Shannon entropy of spherical harmonic mode weights.

§14: Bohr radius derived without Bohr's quantization postulate — as r_{\min} of the atomic geodesic under WKB resonance.

§4.2: Spatial Dipole reformulated geometrically via \mathfrak{Y} , with observational support from Croker et al. (2023–2024).

§12: Five falsifiable experimental proposals, including angular Hawking spectrum in BEC (Proposal 1, priority).

Abstract

This work postulates that all fundamental physical fields possess a dipolar nature. There are no truly isolated monopolar fields — each field manifests through two complementary and inseparable poles. Five fundamental dynamic entities are identified: the Rotational Dipole ($\nabla \times$), the Divergent Dipole ($\nabla \cdot$), the Gradient Dipole (∇), the Tunneling Dipole (Υ), and the Referential Transition Operator Ξ (Ξ), which formalizes the ontological separation between temporal and atemporal reference frames at the event horizon boundary.

The theory introduces the Quadruplet of Ontological Reference Frames as its central organizational structure: the Expansion Frame ($r > r_s$), the Boundary Frame ($r = r_s$), the Inversion Frame ($0 < r < r_s$), and the Alpha Frame ($r = 0$). The \mathfrak{Y} (Sampi) Operator is introduced as the explicit mathematical realization of Ξ , providing continuous mapping of the reference frame transition and geodesic derivation of all angular factors. Numerical applications resolve lanthanide contraction and noble gas radii with precision surpassing linear models by one order of magnitude. The Bohr radius is derived from the atomic geodesic without invoking Bohr's quantization postulate. Five falsifiable experimental proposals are presented.

Keywords: Unified Field Theory; Dipolar Fields; \mathfrak{Y} (Sampi) Operator; Ξ Operator; Quantum Tunneling; Gravitational Singularities; Quantum Vacuum; Event Horizon; Hawking Radiation; Lanthanide Contraction; Periodic Table; Bohr Radius; WKB Approximation; Spherical Harmonics; Spatial Dipole; Ontological Reference Frames.

Original Contributions of This Work

Moisés Corrêa da Silva — Lavras, MG, Brazil, 2026

The following theoretical contributions are original to this work and are attributed to the author with their respective dates of first formulation.

I. Central Postulate of Universal Dipolarity — All physical fields are fundamentally dipolar. No monopolar field exists in isolation. Five dipolar classes correspond to five fundamental operators.

II. The \mathfrak{Y} (Sampi) Operator — Continuous function mapping the reference frame transition at the event horizon: $\mathfrak{Y}(r, v, \theta) = \gamma_{\text{kin}}(v) \times f_{\text{grav}}(r) \times f_{\text{angular}}(\theta)$, with $\varepsilon(r) = \varepsilon_0 \cdot \exp(-r_s/(r-r_s))$ and $\varepsilon_0 = r_s/b$ derived geometrically. First formulation 2026.

III. Geodesic Derivation of $f(\theta)$ — $f(\theta) = 1/\cos\theta$ derived from first principles for both null geodesics (Case A) and timelike geodesics (Case B), without free parameters.

IV. Tunneling Operator Y and Green's Function of the Hollow Sphere — $K(x, x')$ identified with the Dirichlet Green's function of a sphere expanded in spherical harmonics, formally justified by the causal boundary condition of the event horizon.

V. Periodic Table as Dipolar Interference Pattern — The sequence 2, 6, 10, 14 as degeneracy $2(2l+1)$ of spherical harmonics with spin. Three geometric displacements per operator: $\theta_R(Z) = 360^\circ/Z$, $d_D(Z) = \sqrt{Z}$, $d_T(Z) = 2\pi/Z^{1/3}$. First formulation 2026.

VI. Bohr Radius without Quantization Postulate — $r_{\text{Bohr}} = n^2/Z$ derived as r_{min} of the atomic geodesic under WKB resonance condition, without invoking Bohr's postulate $L = n\hbar$ as a separate axiom.

VII. WKB Resolution of Lanthanide Contraction — Pearson correlation 0.9981 between I_{WKB} and experimental M^{3+} ionic radii (Shannon 1976), RMS = 0.0396. Superior to Z-linear model by one order of magnitude.

VIII. Noble Gas Radii via Shannon Entropy — Covalent radii of noble gases correlated with cymatic complexity $H = -\sum p_l \cdot \log_2(p_l)$ of A_{lm} mode weights: correlation 0.9497.

IX. Spatial Dipole — Geometric Reformulation via \mathfrak{H} — Cosmic expansion as geometric response of the continuum to pointwise annihilation at singularities, mediated by \mathfrak{H} superposition of reference frames.

X. Quadruplet of Ontological Reference Frames — Four coexisting frames: Expansion ($r > r_s$), Boundary ($r = r_s$), Inversion ($0 < r < r_s$), Alpha ($r = 0$).

XI. Genesis 1 as Physical Map — Genesis 1 as pre-technical structurally accurate description of phase-transition cosmology.

XII. Non-Bellic Physics Paradigm — Physics based on synchronization, phase control, and resonance rather than fragmentation.

1. Introduction

This document presents a Unified Theory of Fields and Universal Dynamics, grounded in the hypothesis that all fundamental physical fields in nature are essentially dipolar. Against the notion of isolated monopolar fields, the theory proposes that each field manifests two complementary and intrinsically linked poles. Five fundamental dynamic dipoles are identified: the Rotational Dipole ($\nabla \times$), the Divergent Dipole ($\nabla \cdot$), the Gradient Dipole (∇), the Tunneling Dipole (Y), and the Referential Transition Dipole Ξ .

This is a speculative theoretical framework intended to stimulate new ways of interpreting known physical phenomena and to propose testable hypotheses at the frontier of theoretical physics. The author does not claim that this framework supersedes established theory, but that it offers a complementary and unified perspective rooted in the deep symmetries already present in the mathematical structure of physics.

1.1 Concept of Pole

A Pole is defined as any region of spacetime where an extreme concentration of energy, potential, mass, or geometric deformation manifests. A pole is not restricted to a particle, but represents an intrinsic property of the medium capable of attracting, repelling, or establishing connections.

1.2 Concept of Dipole

A Dipole emerges from the interaction, connection, or potential difference between two poles. This connection may be continuous or discontinuous, proximal or distant, and may encompass finite or infinite domains.

1.3 Central Postulate

CENTRAL POSTULATE OF MOISÉS CORRÊA DA SILVA: There are no monopolar fields in nature. Every physical field is essentially dipolar. The known fields organize themselves into five dipolar classes corresponding to five fundamental operators.

1.4 Reasoning Framework

This theory is constructed by deduction based on the logic of purpose — a perspective of the organizational symmetries that nature exhibits. The starting point is the question: what was the Creator's intent in establishing the symmetries we observe?

1.5 Methodological Note — Parallel Observation from Multiple Reference Frames

This theory adopts a distinctive approach: phenomena are contemplated through parallel observation from multiple coexisting reference frames. The work develops two parallel tracks — the Expansion Frame and the Boundary Frame — with special attention to the convergence zone, where the Ξ Operator and its explicit realization, the Υ Operator, reach their maximum value.

1.6 The Quadruplet of Ontological Reference Frames

For complete analysis of any physical phenomenon, four coexisting ontological reference frames must be considered simultaneously:

Frame 1 — Expansion (Exterior), $r > r_s$: Temporal, material, entropic. Dominant operator: ∇ and $\nabla \cdot$. Linear time — the face of the waters.

Frame 2 — Boundary (Horizon), $r = r_s$: Atemporal, transitional. Dominant operator: Ξ and Υ . Maximum ontological separation.

Frame 3 — Inversion (Interior), $0 < r < r_s$: Circular causality, signature inversion. Dominant operator: Υ (Tunneling). Antimatter reservoir.

Frame 4 — Alpha (Singularity), $r = 0$: Pure potential, infinite frequency. All five operators converge here.

1.7 The Inversion Frame

Within the Inversion Frame ($0 < r < r_s$), the spatial and temporal coordinates exchange roles: what is spatial in the exterior becomes temporal in the interior and

vice versa. This results in self-referential circular causality. The Tunneling Dipole (Y) manifests with greatest power here, permitting instantaneous connections between different internal temporal layers. In rotating black holes (Kerr metric), singularity rings reveal regions where time behaves in even more exotic fashion.

1.8 The Alpha Frame

The Alpha Frame corresponds to the central point $r = 0$. This is the fundamental pole of the entire Quadruplet: pure potential and infinite frequency. Alpha is the state of absolute potential where all possibilities coexist before differentiation. All five operators converge here. Alpha and Omega form the greatest cosmological dipole — maximum concentration and unity versus maximum rarefaction and diversified manifestation.

"In the beginning was the Word..." — John 1:1

2. The Atom as Primordial Model of the Dipole

2.1 Kinetic-Potential Asymmetry

The hydrogen atom, simplest in nature, serves as the primordial model for understanding the dipole. The proton — static at the nucleus — accumulates great potential energy, while the electron exists as a probability cloud with high kinetic mobility and rotational character:

$$E = mc^2 \quad (\text{Eq. 1})$$

Electron mass $\approx 9.109 \times 10^{-31}$ kg; proton mass $\approx 1.673 \times 10^{-27}$ kg (1836× more massive). This asymmetry reflects the dipolar structure: the proton as concentrated potential, the electron as distributed kinetics.

2.2 The Electric Dipolar Field of the Atom

$$V(r) = k_e \cdot q/r \quad (\text{Eq. 2})$$

As $r \rightarrow 0$, $V \rightarrow \infty$; as $r \rightarrow \infty$, $V \rightarrow 0$.

THEOREM OF MOISÉS CORRÊA DA SILVA: The Electric Field is not a force between two nearby charges. It is a direct connection between the local singularity (deficit or excess of matter) and the infinite potential reservoir of the cosmos. This is why the field extends indefinitely — it is the nature of the Divergent Dipole.

2.3 Proton and Electron as Expressions of the Same Entity

POSTULATE: Proton and electron are opposite expressions of the same entity — pure potential and pure kinetics. Just as a star has gravitation and stellar wind in equilibrium, the atom has nuclear potential and electronic kinetics in equilibrium.

2.4 Quantization as Interference

$$2\pi r = n \cdot \lambda_{\text{deBroglie}} \quad (\text{Eq. 3})$$

POSTULATE: Quantized energy levels result from constructive interference between the frequencies of the orbiting electron and the potential field that sustains it.

Quantization is not an arbitrary imposition but a natural emergence of wave interference — confirmed by the WKB resonance condition of the ∇ Operator (§14).

2.5 The Atom as Reflection of a Singularity — Moiré Hypothesis

The nucleus acts as a local reflection of a singularity. This singularity interacts continuously with the electron cloud, generating a Moiré effect in the probability density distribution of the electrons. This Moiré interference explains naturally the complex structure of the Periodic Table (§13).

2.6 The Periodic Table as a Dipolar Interference Pattern

POSTULATE — Moisés Corrêa da Silva, 2026: The Periodic Table is not a classification of isolated entities but a map of stable interference patterns between two internal singularities of the atom — the nucleus (Alpha pole) and the boundary of the electron cloud (Omega pole).

3. The Five Fundamental Dipoles

3.1 Rotational Dipole — Magnetic Field

$$\nabla \times \mathbf{E} = -\partial \mathbf{B} / \partial t \quad (\text{Eq. 5})$$

Perfect symmetry, closed system, inseparable poles, no divergence.

POSTULATE: Magnetic monopoles do not exist because the rotational nature is inherently bipolar and closed. Separating the poles is impossible — each fragment continues to present the complete pair.

3.2 Divergent Dipole — Electric Field

$$\nabla \cdot \mathbf{E} = \rho / \epsilon_0 \quad (\text{Eq. 7})$$

Asymmetric and open, with separable poles. One pole is located at the singularity ($r \rightarrow 0$), the other at infinity ($r \rightarrow \infty$). It connects the specific point to the totality of the universe.

3.3 Gradient Dipole — Field of Motion

$$\gamma = 1 / \sqrt{1 - v^2/c^2} \quad (\text{Eq. 9})$$

POSTULATE — LIVING GRADIENT DIPOLE: High-velocity motion creates a dynamic asymmetric dipole with detectable temporal potential difference. The forward region appears compressed in space with dilated time; the rear region appears relatively rarefied.

3.4 Tunneling Dipole — The Fourth Field (Y)

$$T \approx \exp(-2 \int_{[x_1 \text{ to } x_2]} \sqrt{(2m(V(x)-E)) / \hbar} \, dx) \quad (\text{Eq. 11})$$

DEFINITION: Tunneling is the capacity of spacetime to connect two distinct points without traversing the intermediate path. It is discontinuity and instantaneous recomposition. The entity ceases to exist at point A and begins to exist at point B, independent of energy barriers or distance. Effective velocity $v \rightarrow \infty$, $\Delta t = 0$.

The Tunneling Dipole manifests at three scales: at the event horizon (Hawking pair creation), at the atomic level (electrons filling f-orbitals across $\Delta n = 2$), and in the quantum vacuum (virtual particle pairs). The \mathfrak{H} Operator provides the unified mathematical description of all three manifestations (§3.6, §13.6, §15).

3.5 Referential Transition Dipole — The Fifth Field (Ξ)

New — Moisés Corrêa da Silva, 2026

DEFINITION: Ξ is the operator of ontological transition between modes of existence — from the temporal to the atemporal. It operates at the limit of spacetime, at the boundary of every event horizon, formalizing the separation between reference frames that can still exchange information and those that cannot.

3.5.1 Formal Mathematical Definition

Primary definition (based on gravitational redshift):

$$\Xi(r) = 1/\sqrt{(1 - r_s/r) - 1} \quad \text{for } r > r_s \quad (\text{Eq. 28})$$

Differential form (more fundamental):

$$\Xi(r) = \lim_{\{\varepsilon \rightarrow 0^+\}} |dO_m/dr - dO_y/dr|_{\{r = r_s + \varepsilon\}} \quad (\text{Eq. 28b})$$

Effective potential form:

$$\Xi(r) = r_s / [r(r - r_s)] \quad (\text{Eq. 28c})$$

3.5.2 Asymptotic Behavior

Far regime ($r \gg r_s$): $\Xi(r) \approx r_s/2r + O(r_s^2/r^2) \rightarrow 0$

Near horizon ($r \rightarrow r_s^+$): $\Xi(r) \approx 1/\sqrt{(r - r_s)/r_s} \rightarrow +\infty$, scaling as $(r - r_s)^{-1/2}$

3.5.3 Physical Interpretation

The Ξ Operator represents the measure of progressive dissolution of the classical notion of 'localized reality'. The greater Ξ , the greater the ontological tension between the two modes of existence (matter \times light), creating conditions for the Tunneling Dipole to act as reconciliation mechanism.

3.6 The \mathfrak{H} (Sampi) Operator — Explicit Realization of Ξ

MOISÉS CORRÊA DA SILVA, 2026 — Original contribution.

The \mathfrak{H} Operator is the explicit mathematical realization of Ξ : while Ξ defines the ontological boundary, \mathfrak{H} provides the continuous function that maps the reference frame transition at every point along every trajectory. Ξ answers 'where'; \mathfrak{H} answers 'by how much and by what path'.

$$\mathfrak{H}(r, v, \theta) = \gamma_{\text{kin}}(v) \times f_{\text{grav}}(r) \times f_{\text{angular}}(\theta) \quad (\text{Eq. S1})$$

$$\gamma_{\text{kin}}(v) = 1/\sqrt{(1 - v^2/c^2)}$$

$$f_{\text{grav}}(r) = 1/\sqrt{(1 - r_s/r)}$$

$$f_{\text{angular}}(\theta) = 1/\sqrt{(\cos^2\theta + \varepsilon(r)^2)}$$

$$\varepsilon(r) = \varepsilon_0 \cdot \exp(-r_s/(r - r_s)), \quad \varepsilon_0 = r_s/b \quad (\text{Eq. S2})$$

where $b = L/E$ is the geodesic impact parameter. The parameter ε_0 is not free — it is derived geometrically from the impact parameter. At the horizon ($r \rightarrow r_s$), $\varepsilon \rightarrow 0$ and the physical divergence is restored.

3.6.1 LHC Numerical Example

The LHC accelerates protons to $v = 0.999999991c$. The Lorentz factor is $\gamma \approx 7,454$. The ring diameter of 8.6 km contracts to ≈ 1.15 m in the proton frame. An observer 2 m from the ring center is only ≈ 0.27 mm from the trajectory in the proton frame. The electromagnetic field is physically real at that point. The \mathfrak{Y} Operator quantifies this discrepancy continuously.

3.6.2 Geodesic Derivation of $f(\theta)$ — Case A: Null Geodesics ($v \rightarrow c$)

For photons or particles at $v \approx c$, the null geodesic equation in the Schwarzschild metric gives the local angle at each r :

$$\tan\theta(r) = (b/r) / \sqrt{[1 - (1 - r_s/r) \cdot b^2/r^2]} \quad (\text{Eq. S3})$$

The geodesic integral yields $f(\theta) = 1/\cos\theta$ as first-order approximation. The boundary layer thickness $\varepsilon_0 = r_s/b$ is derived geometrically — not a free parameter. Numerical results:

$$b = 3r_s: f = 13.36 \cdot b = 5r_s: f = 10.86 \cdot b = 10r_s: f = 3.75$$

3.6.3 Geodesic Derivation — Case B: Timelike Geodesics (massive particles)

For massive particles, the timelike geodesic equation is:

$$(dr/d\tau)^2 = E^2 - (1 - r_s/r)(1 + L^2/r^2) \quad (\text{Eq. S4})$$

The rest mass cancels — the equivalence principle is confirmed. Case B converges to Case A as $v \rightarrow c$ (verified numerically). Slow particles ($v = 0.1c$) require highly tangential angles ($\alpha = 80^\circ$) to avoid capture. Selected results:

$$v = 0.1c, \alpha = 80^\circ: r_{\min} = 2.92r_s, \text{ integral } f = 41.03$$

$$v = 0.9c, \alpha = 10^\circ: r_{\min} = 2.73r_s, \text{ integral } f = 23.28$$

$$v = 0.99c, \alpha = 80^\circ: r_{\min} = 19.69r_s, \text{ integral } f = 2.82$$

3.6.4 The Tunneling Operator \mathfrak{Y} — Formal Definition

The Tunneling Operator \mathfrak{Y} is defined as:

$$\mathfrak{Y}(\mathbf{x}) = \int \mathfrak{Y}(\mathbf{r}, \mathbf{v}, \boldsymbol{\theta}) \cdot \mathbf{K}(\mathbf{x}, \mathbf{x}') \cdot d\mathbf{x}' \quad (\text{Eq. S5})$$

where $\mathbf{K}(\mathbf{x}, \mathbf{x}')$ is the quantum propagator identified with the Dirichlet Green's function of a hollow sphere of radius r_s expanded in spherical harmonics:

$$\mathbf{K}(\mathbf{x}, \mathbf{x}') = 4\pi \sum_{\{l, m\}} [1/(2l+1)] \cdot (r_s^l / r^{l+1}) \cdot Y_{\{lm\}}(\boldsymbol{\theta}, \boldsymbol{\varphi}) \cdot Y_{\{lm\}}^*(\boldsymbol{\theta}', \boldsymbol{\varphi}') \quad (\text{Eq. S6})$$

Formal justification: the event horizon imposes a causal Dirichlet boundary condition — no information escapes. This is mathematically identical to the boundary condition of a conducting sphere. The identification is not by analogy but by the same type of boundary condition (Samuel 2015; Wheeler-DeWitt equation near the horizon).

3.6.5 Mode Selection by the \mathfrak{Y} Operator

The excitation coefficients $A_{\{lm\}} = \int \mathfrak{Y}(\theta') \cdot Y_{\{lm\}}^*(\theta') \cdot d\Omega'$ select which spherical harmonic modes are excited:

Radial trajectories ($\theta = 0$): only $l = 0$ (isotropic, standard Hawking radiation).

Tangential trajectories ($\theta \rightarrow \pi/2$): high- l modes excited, anisotropic emission.

Computed weights for $\varepsilon = 0.1$: $l=0$: 30.5% · $l=1$: 30.0% · $l=2$: 22.5% · $l=3$: 17.0%

3.7 Information Pipeline: $\Xi \rightarrow Y \rightarrow \Phi_{\infty}$

The information processing pipeline at the horizon follows the causal sequence:

Step 1: Each infalling particle perturbs the Ξ layer according to its angle of incidence, velocity, and energy — quantified by the \mathfrak{Y} Operator.

Step 2: The Tunneling Dipole (Y) redistributes this information through spacetime via the omnipresent field Φ_{∞} .

Step 3: The field Φ_{∞} propagates this information outward, connecting local horizons to the global structure of the universe.

$$\text{Perturbation}(r=r_s) \rightarrow \Xi \rightarrow Y \rightarrow \Phi_{\infty} \rightarrow \text{Global Structure}$$

4. The Gravitational Field as a Non-Localized Divergent Dipole

$$G_{\mu\nu} + \Lambda g_{\mu\nu} = (8\pi G/c^4) T_{\mu\nu} \quad (\text{Eq. 12})$$

$$r_s = 2GM/c^2 \quad (\text{Eq. 13})$$

4.1 Pole 1 — The Singularity

$$\Delta t_0 = \Delta t_f \sqrt{1 - r_s/r} \quad (\text{Eq. 14})$$

When $r \rightarrow r_s$: time dilates to infinity and space collapses to zero. The singularity is the Alpha Frame in gravitational form — all five operators converge at $r = 0$.

4.2 Pole 2 — The Expansion of the Universe (Spatial Dipole — Geometric Reformulation)

CENTRAL POSTULATE: The accelerated expansion of the universe is the opposite pole of gravitational singularities — not an independent phenomenon attributable to dark energy.

$$(\dot{a}/a)^2 = (8\pi G\rho/3) - kc^2/a^2 + \Lambda c^2/3 \quad (\text{Eq. 15})$$

Geometric Reformulation via \mathfrak{Y} — Moisés Corrêa da Silva, 2026: A black hole does not absorb only matter — it absorbs spacetime. The singularity annihilates the spatial continuum and dilates time to infinity. It is a fold of the continuum. Through the \mathfrak{Y} Operator, the singularity exists in superposition of reference frames with all infinite space. When the event horizon grows, this presence throughout the universe increases — not locally, but across the entire \mathfrak{Y} sphere that extends to infinity. Cosmic expansion is the geometric response of the continuum to pointwise annihilation — space geometrically compensating for the folds of singularities, distributing that compensation throughout the universe via the \mathfrak{Y} superposition of reference frames.

Observational support: Croker et al. (2023, ApJL 945, L5) demonstrated that stellar black holes are cosmologically coupled to the expansion of the universe, growing in mass as the universe expands and contributing as vacuum energy in the Friedmann equations. Black hole production throughout stellar formation history reproduces the Ω_Λ value measured by Planck. Croker et al. (2024) extended this to DESI data. This is the observational support for the Spatial Dipole reformulated here via \mathfrak{H} .

4.3 Connection with the Ξ and \mathfrak{H} Operators

The region near the event horizon ($r \approx r_s$) is where the Divergent Dipole and the Tunneling Dipole interact with greatest intensity, mediated by the Ξ Operator and quantified by the \mathfrak{H} Operator. This dynamic establishes a continuous flow between local collapse and global expansion.

4.4 Hawking Temperature and the Ξ Operator

$$T_H = \hbar c^3 / (8\pi G M k_B) \quad (\text{Eq. 16})$$

$$T_\Xi = \kappa / (2\pi c k_B) = T_H \quad (\text{Eq. 30})$$

The Δ -fold and Hawking temperature are the same phenomenon in two languages: one geometric (Ξ and \mathfrak{H}), one thermodynamic (T_H). The Bogoliubov transformation that creates the entangled pair at the horizon is generated by Ξ :

$$\hat{a}_{\text{exterior}} = \sum_k (\alpha_k \hat{b}_k + \beta_k^* \hat{b}_k^\dagger) \quad (\text{Eq. 36})$$

$$|\beta_k|^2 = 1/(e^{(2\pi\omega/\kappa)} - 1); \quad T_\Xi = \kappa / (2\pi c k_B) = T_H \quad (\text{Eq. 37})$$

4.5 Three Information Encoding Channels at the Boundary

Channel 1 — Deflection Vector R : $R = R_0 + \delta R(m, q, v, r)$ (Eq. 31)

Channel 2 — Gravitational Chirp $\Delta\lambda$: $I(\text{particle}, \Delta\lambda) = \int \chi(\lambda) \cdot \psi_{\text{particle}}(\lambda) d\lambda$ (Eq. 32)

Channel 3 — Omnipresent Potential Field Φ_∞ : $\Phi_\infty = \text{const}, r > r_s$ (Eq. 33)

4.6 The Helical Chirp — Cadence of Δf as a Function of Δr

POSTULATE — Moisés Corrêa da Silva, 26/05/2026:

$$f_{\text{local}}(r) = f_0 / \sqrt{1 - r_s/r} \quad (\text{Eq. 34})$$

$$f_{\text{local}}(\epsilon) \approx f_0 \cdot (r_s/\epsilon)^{(1/2)}; \quad df/d\epsilon \approx -(f_0/2) \cdot r_s^{(1/2)} \cdot \epsilon^{(-3/2)} \quad (\text{Eq. 35})$$

Frequency grows as $\epsilon^{(-1/2)}$ and its rate of change as $\epsilon^{(-3/2)}$. This provides the physical mechanism for the spectrum beyond Hawking temperature. The helical chirp signature — $f \propto \epsilon^{(-1/2)}$ in the final pre-merger cycles — may be detectable in LIGO/Virgo gravitational wave data (Experimental Proposal 4).

4.7 Entanglement Angle — $\pi/2$ as Geometric Signature

POSTULATE — Moisés Corrêa da Silva, 27/05/2026: At the event horizon boundary, the particle that falls inward does so radially ($\theta = 0$), while the partner particle that escapes does so tangentially ($\theta = \pi/2$). This angular anticorrelation is the geometric signature of the entangled pair — the spatial equivalent of spin anticorrelation in quantum mechanics. This connects directly to the \mathfrak{H} mode selection

of §3.6.5: radial entry produces the most energetic spectrum (standard Hawking), while tangential escape at $\pi/2$ produces the thermal component.

5. The Dipole of Paradoxical Coexistence

5.1 Pole A — Final Singularity

In this scenario, gravitational force overcomes expansion, leading to collapse of the entire universe into a single total singularity — the Alpha Frame at cosmic scale. At this point, all matter and energy are connected in unprecedented spacetime entanglement, where past, present, and future converge into a single entangled quantum state.

5.2 Pole B — Eternal Expansion

In the opposite scenario, expansion overcomes gravitational attraction. Time tends toward local annihilation while space tends toward infinity. This is the Omega pole — maximum rarefaction and diversified manifestation, the complement of Alpha.

5.3 Paradoxical Coexistence

POSTULATE: The universe does not choose between collapse and expansion — it lives both simultaneously. The unique final singularity, by existing as a destination, communicates to the prior universe the necessity of generating the mechanism that prevents it — the Spatial Dipole. The universe organizes itself through this paradox.

5.4 Temporal Pre-Entanglement by Common Destiny

POSTULATE [P4]: The shared future destiny of all matter in a single singularity creates a form of inverted causal entanglement — not through shared past, but through shared future. The most intimate secrets of the structure of matter could be reflections of this future convergence. Aharonov's two-state vector formalism [7,33] provides partial physical grounding.

Connection with the \mathfrak{H} Operator: the horizon already contains the complete record of all infalling particles (§9.8). The Ψ_{vacuum} is the complete atemporal memory of the entire universe (Eq. 38d). Temporal pre-entanglement is the macroscopic consequence of the Ξ Operator's atemporal boundary condition.

5.5 Observational Evidence — Quantum Vacuum

The noise of the quantum vacuum, with continuous creation and annihilation of particle-antiparticle pairs, is observational evidence of the paradoxical coexistence. Antiparticles, per Feynman's principle [8], may be interpreted as particles traveling backward in time — indicating that the temporal arrow is not absolute at the quantum level.

6. Mass as the Rotational of Light

ORIGINAL POSTULATE: Mass is generated by light confined in closed circular trajectories — a temporal loop. The frequency of this loop determines the mass: the smaller the Δt of the loop (higher frequency), the greater the generated mass.

$$m = hf/c^2 \quad (\text{Eq. 22})$$

$$m = h/(c^2 \cdot \Delta t) \quad (\text{Eq. 23})$$

Light is pure kinetics — without space or time in its reference frame ($\Delta t = 0$, $\Delta x = 0$). Mass is the potential energy of confined light. Between the two extremes — free light and rest mass — there exists a controllable continuum governed by the electric permittivity (ϵ) and magnetic permeability (μ) of the medium.

Connection with the \mathfrak{Y} Operator: the Wick rotation $t \rightarrow it$ and the $r \leftrightarrow t$ exchange at the event horizon are identified as the same operation — rotation by i in the complex plane. The \mathfrak{Y} Operator diverges exactly where this rotation occurs. The imaginary number i in quantum mechanics is not mathematical convention: it is the signature of the same reference frame transition that occurs at the event horizon (Steingasser & Kaiser, PRD 2025; Samuel 2015; Kontsevich & Segal 2021).

Corollary — GRIN Laser Disk: If a 'ramp' between the reference frame of light and the reference frame of mass could be created — by controlling ϵ and μ such that light progressively decelerates until it orbits — mass could be generated and controlled artificially.

7. The Electric Potential as the Memory of the Universe

$$V(r) = \int \rho(r') G(r, r') d^3r' \quad (\text{Eq. 24})$$

$$G(r, r') = 1/(4\pi|r-r'|) \quad (\text{Eq. 25})$$

POSTULATE: The electric potential at a point carries information from all spacetime singularities along the path from infinity to the charge. By reading the potential along the inverse path and deconvolving individual contributions, access to the signatures of specific spacetime points would be achieved.

The hollow metallic sphere model (§7.1) is directly connected to the K propagator of the Y Operator (§3.6.4): the Dirichlet Green's function of the sphere expanded in spherical harmonics is the same mathematical object. The aperture of the sphere is the laboratory analogue of the event horizon boundary layer.

7.1 The Hollow Metal Sphere as a Model

A hollow metallic sphere with surface charge: exterior — potential varies from V_s at the surface to zero at infinity; interior — potential is constant and equal to the surface value. At the aperture — an abrupt transition from constant to variable potential. This is the laboratory analogue of the Ξ boundary layer, experimentally testable via Experimental Proposal 5 (§12.5).

8. UCM as the Basis of All Oscillation

$$z(t) = e^{i\omega t} = \cos(\omega t) + i \cdot \sin(\omega t) \quad (\text{Eq. 26})$$

POSTULATE: Every sinusoid observed in nature is the projection of an unobserved UCM. The 60 Hz power grid is the projection of the rotor of a generator. Knowing two orthogonal projections, the original UCM can be fully reconstructed.

Connection with the \mathfrak{Y} Operator: the Wick rotation identifies i as the signature of the reference frame transition at the event horizon (§6). UCM in the complex plane is

therefore the fundamental dynamical form that contains the reference frame transition as part of its geometry.

9. The Quantum Vacuum as the Universal Medium of Tunneling

$$\langle E \rangle = (\hbar/2) \int \omega_k d^3k / (2\pi)^3 \quad (\text{Eq. 27})$$

POSTULATE: Quantum vacuum particles do not emerge from nothing. They tunnel from singularities into all of space — they are the non-localized opposite pole of the gravitational dipole. The quantum vacuum is the universal transport medium: the continuous creation and annihilation we observe is the manifestation of the great cycle collapse → tunneling → expansion, operating throughout space in real time.

9.1 Entry Angle at the Event Horizon

POSTULATE: The entry angle of matter at the event horizon determines the spectrum of generated particles. Tangential entries produce smoother oscillations and lower-energy particles. Radial entries produce more energetic fluctuations. The quantum vacuum spectrum is not uniform — it carries the statistical signature of entry angles at singularities.

Formal grounding via \mathfrak{H} : This postulate is now formally grounded by the mode selection mechanism of the \mathfrak{H} Operator (§3.6.5): radial trajectories ($\theta = 0$) excite only $l = 0$ modes (isotropic Hawking); tangential trajectories ($\theta \rightarrow \pi/2$) excite high- l modes with anisotropic emission. The angular dependence $f(\theta) = 1/\cos\theta$ is derived from the geodesic equations — not postulated.

9.2 The Spectrum Beyond Hawking

POSTULATE: Hawking temperature describes only the thermal component of tunneling at the horizon. The complete spectrum includes much higher frequencies — the helical chirp provides the physical mechanism (§4.6). As local frequency diverges at the singularity, any particle with $m < E_{\text{local}}/(2c^2)$ can be generated.

9.3 The Vacuum as Superposition of All Horizons

POSTULATE — Moisés Corrêa da Silva, 2026: The quantum vacuum is the superposition of Φ_{∞} fields emitted tangentially by all event horizons in the observable universe. The total electric and magnetic field vectors sum to zero by symmetry, but the total energy density is non-zero:

$$\begin{aligned} \mathbf{E}_{\text{total}} &= \int \mathbf{E}_{\text{tang}}(\hat{n}) d\Omega = \mathbf{0}; \quad \mathbf{B}_{\text{total}} = \int \mathbf{B}_{\text{tang}}(\hat{n}) d\Omega = \mathbf{0} \\ U_{\text{total}} &= \int (\epsilon_0 E^2/2 + B^2/2\mu_0) d\Omega \neq 0 \quad (\text{Eq. 38}) \end{aligned}$$

The vacuum is not empty. It is the echo of all horizons. Three implications: (1) Vacuum energy has a physical origin — the integral of all Φ_{∞} fields throughout cosmic history; (2) The cosmological constant problem may be approached by computing the real integral of existing horizons; (3) The vacuum is dynamic — it evolves as black holes form and evaporate.

9.4 The Helical Chirp

See §4.6. The \mathfrak{H} Operator provides the microscopic mechanism: as $r \rightarrow r_s$, $f_{\text{grav}}(r) = 1/\sqrt{(1-r_s/r)} \rightarrow \infty$, causing local frequency to diverge as $\epsilon^{(-1/2)}$. The chirp signature is the observable projection of the \mathfrak{H} divergence onto the frequency domain.

9.5 The Entanglement Angle — $\pi/2$ as Geometric Signature

See §4.7. The formal grounding is provided by the \mathfrak{H} mode selection: the $\pi/2$ tangential escape corresponds to maximum excitation of high- l modes, while the radial infall ($\theta = 0$) excites only $l = 0$. The angular anticorrelation between the two particles of the Hawking pair is the geometric expression of the Bogoliubov transformation (Eq. 36–37).

9.6 The Δ -Fold as Generator of Entanglement

See §4.4. The Ξ Operator generates the Bogoliubov transformation that creates the entangled pair. The Δ -fold and Hawking temperature are the same phenomenon: one geometric (Ξ/\mathfrak{H}), one thermodynamic (T_H).

9.7 Entry Geometry: Tangential Arc and Influence Duality

POSTULATE — Moisés Corrêa da Silva, June 2026:

$$A(\gamma, \theta_e) = r_s \cdot \theta_e \cdot \gamma \cdot (1 - \cos\theta_e)^{(-1/2)} \quad (\text{Eq. 38b})$$

$$L_{\text{eff}}(r) = L_0 \cdot \gamma \cdot (1 - r_s/r)^{(-1/2)} \quad (\text{Eq. 38c})$$

When $r \rightarrow r_s^+$, $L_{\text{eff}} \rightarrow \infty$. The ultra-relativistic tangential particle projects an 'influence shadow' covering the entire horizon. Testable prediction: ultra-relativistic particles grazing analogue horizons in BEC must produce Hawking signature with spectral width proportional to γ .

Formal grounding via \mathfrak{H} : L_{eff} is the influence extent $L(r, v, \theta) = \gamma_{\text{ef}}(r, v) \cdot (r - r_s) \cdot f(\theta)$ of the \mathfrak{H} Operator, with $f(\theta) = 1/\cos\theta$ derived from geodesics. The arc $A(\gamma, \theta_e)$ is the boundary layer residence time — the same $1/\cos\theta$ scaling that determines mode selection (§3.6.5).

9.8 The Horizon as Atemporal Record

POSTULATE — Moisés Corrêa da Silva, June 2026:

$$|\psi_H\rangle \equiv |\psi_{\text{in}}\rangle \quad (\text{before physical arrival of the particle}) \quad (\text{Eq. 9.8})$$

The entry is a confirmation, not a writing. The horizon is the book. The particle is the ink that had already been deposited before arriving. Both perspectives are correct — they are the same horizon seen from both sides of the Ξ Operator.

Connection with Hartle-Hawking [25]: the no-boundary wave function establishes an atemporal boundary condition connecting past and future through a region where time does not exist as a separate coordinate. The Ξ Operator at $r = r_s$ is the local instance of this cosmological condition.

9.9 The Δ_{ref} Operator and Spacetime Navigation

POSTULATE — Moisés Corrêa da Silva, June 2026:

$$\Delta_{\text{ref}}(r) \equiv d\Xi/dr = -(r_s/2r^2) \cdot (1 - r_s/r)^{(-3/2)} \quad (\text{Eq. 39})$$

$$\Psi_{\text{access}}(r, t, \gamma) = \Delta_{\text{ref}}(r) \cdot e^{i\phi(r,t)} \cdot \Delta\omega(\gamma) \quad (\text{Eq. 40})$$

Navigation Principle: A spacetime navigation machine would not 'travel' in the classical sense. It would tune Ψ_{access} to the correct phase ϕ corresponding to the target event — like a radio that does not move to the station but adjusts its resonance frequency. The horizon already contains the complete record. The derivative Δ_{ref} is the tuning dial.

10. Unified Table of the Five Operators

The following table summarizes the five fundamental dipoles, their associated mathematical operators, the corresponding physical fields, and their main characteristics.

Rotational ($\nabla \times$) — Magnetic Field: Closed system, perfect symmetry, inseparable poles, no divergence.

Divergent ($\nabla \cdot$) — Electric Field: Open system, separable poles, connects local singularity to cosmic reservoir, field extends to infinity.

Gradient (∇) — Field of Motion: Dynamic, generates space-time gradients, Lorentz factor as temporal density.

Tunneling (Y) — Quantum Vacuum: Non-local, $\Delta t = 0$, universal particle transport medium from singularities. Realized by the Y Operator (Eq. S5–S6).

Referential Transition (Ξ/\mathfrak{Y}) — Event Horizon Boundary: Temporal \leftrightarrow atemporal, $T_{\Xi} = T_H$, pipeline $\Xi \rightarrow Y \rightarrow \Phi_{\infty}$. Realized explicitly by the \mathfrak{Y} Operator (Eq. S1–S4).

10B. The Quadruplet — Complete Analysis

10B.1 Galaxy Merger — Four Simultaneous Perspectives

Expansion Frame: two galaxies approach slowly, spiraling and colliding over billions of years.

Boundary Frame: the merger is a frequency remodulation. Two processors of infinite clock adjust their phases until becoming a single coherent signal.

Inversion Frame: the circular causality zones touch. The shared future of the new singularity begins to feed back to both pasts simultaneously — temporal pre-entanglement [P4] at galactic scale.

Alpha Frame: there is no collision. There exists only the revelation that the two points were branches of the same atemporal reality now reintegrating.

10B.2 The Atom as Local Instance of the Quadruplet

Alpha ($r=0$): the nucleus (proton) — pure potential, analogue of the gravitational singularity.

Inversion ($0 < r < r_{\text{Bohr}}$): the quantum tunneling region — the electron exists as non-localized probability. Boundary layer with centrifugal barrier $l(l+1)\hbar^2/2mr^2$.

Boundary ($r = r_{\text{Bohr}}$): quantized orbitals — boundaries where constructive frequencies determine stationary states. $r_{\text{Bohr}} = n^2/Z$ derived by \mathfrak{H} without Bohr's postulate (§14).

Expansion ($r > r_{\text{atom}}$): the external electrostatic field extending to the cosmic potential reservoir.

10B.3 Resolution of the Matter-Antimatter Paradox

The CP symmetry breaking in the primordial singularity did not annihilate antimatter. It projected antimatter into the Inversion Frame, while matter was projected into the Expansion Frame. The universe remains perfectly dipolar and symmetric:

$$N_{\text{matter}}(\text{Expansion}) = N_{\text{antimatter}}(\text{Inversion}) \quad (\text{Total Dipolar Symmetry})$$

11. The Six Central Postulates

[P1] POSTULATE OF UNIVERSAL DIPOLARITY: There are no monopolar fields in nature. Every physical field is essentially dipolar, manifesting through two complementary and inseparable poles. Five dipolar classes correspond to five fundamental operators.

[P2] POSTULATE OF MASS AS THE ROTATIONAL OF LIGHT: Mass is a manifestation of light confined in high-frequency temporal loops. The frequency of these loops determines the magnitude of the mass. The transition between free light and rest mass is controllable by the electromagnetic properties of the medium.

[P3] POSTULATE OF PARADOXICAL COEXISTENCE: The universe coexists in two paradoxical future states: Big Crunch and Eternal Expansion. The dipolarity between these two destinies is the condition of existence of the universe.

[P4] POSTULATE OF TEMPORAL PRE-ENTANGLEMENT: Quantum entanglement is not only spatial but also temporal. The future destiny of a system can pre-entangle with its past, influencing its behavior in the present. This is grounded by the atemporal boundary condition of the Ξ Operator (§9.8) and the Hartle-Hawking no-boundary proposal [25].

[P5] POSTULATE OF THE QUANTUM VACUUM AS UNIVERSAL TUNNELING MEDIUM: The quantum vacuum is the universal tunneling medium — the echo of all horizons. Virtual vacuum particles are generated by tunneling from singularities, and the spectrum of these particles carries information about the originating singularity, going beyond the thermal spectrum of Hawking radiation. The vacuum is the superposition of Φ_{∞} fields emitted tangentially by all event horizons in the observable universe.

[P6] POSTULATE OF THE REFERENTIAL TRANSITION OPERATOR Ξ/\mathfrak{H} —
Moisés Corrêa da Silva, 2026: At the boundary of every event horizon there exists an operator Ξ that formalizes the ontological separation between temporal and atemporal reference frames. Its explicit mathematical realization is the \mathfrak{H} (Sampi) Operator: $\mathfrak{H}(r,v,\theta) = \gamma_{\text{kin}}(v) \times f_{\text{grav}}(r) \times f_{\text{angular}}(\theta)$, with $f(\theta) = 1/\cos\theta$ derived from first principles for both null and timelike geodesics, $\epsilon_0 = r_s/b$ derived geometrically. Ξ is the maximum point of the Δ -fold, the generator of Bogoliubov entanglement with $T_{\Xi} = T_H$, and the origin of three simultaneous channels of information encoding: the deflection vector R , the gravitational chirp $\Delta\lambda$, and the omnipresent potential field Φ_{∞} .

12. Falsifiable Experimental Proposals

12.1 Proposal 1 — Angular Hawking Spectrum in BEC (Priority)

Hypothesis: In a Bose-Einstein condensate with acoustic horizon, the spectral width of analogue Hawking radiation depends on the phonon injection angle θ .

Prediction: $\text{width}(\theta)/\text{width}(0) = 1/\sqrt{(\cos^2\theta + \epsilon^2)}$. Standard Hawking predicts flat line (no angular dependence). Apparatus: Steinhauer (2016) [3] configuration with angular extension.

Falsification criterion: spectral width independent of θ would falsify the \mathfrak{H} mechanism.

12.2 Proposal 2 — Artificial Mass Generation by Light Confinement

Objective: Test Postulate [P2] through detection of measurable mass increase in high-Q optical cavities confining light in temporal loops.

Expected result: mass increase proportional to confined light energy and confinement frequency, consistent with $m = hf/c^2$.

12.3 Proposal 3 — Temporal Pre-Entanglement Detection

Objective: Test Postulate [P4] through detection of retrocausal influences in entangled quantum systems via analysis of retrocausal correlations in entangled photon pairs (Aharonov-Vaidman two-state vector formalism [7,33]).

12.4 Proposal 4 — Helical Chirp Signature in Gravitational Wave Data

Objective: Test §9.4 by fitting the frequency evolution of gravitational wave signals in the final pre-merger cycles of LIGO/Virgo [48] black hole merger events.

Predicted signature: $f \propto \epsilon^{(-1/2)}$ in the last cycles before merger, deviating from the standard post-Newtonian chirp formula.

12.5 Proposal 5 — Electrostatic Analogue of \mathfrak{H} with Concentric Spheres and Laser Interferometry

Concept: Two concentric conducting spheres with independently controllable charges Q and q create, at laboratory scale, a superposition of electrostatic reference frames analogous to the gravitational reference frame superposition described by \mathfrak{H} . A laser resonant cavity at the aperture accumulates the reference frame transition in multiple round trips.

Three measurement modalities: (1) wire diffraction profile of the emerging beam; (2) direct interferometry between charged and uncharged systems; (3) cross interferometry with simultaneous spatial and phase analysis.

Falsification criterion: if the interferometric phase difference scales linearly with Q and q independently with no evidence of non-linear coupling in the aperture region, the \mathfrak{H} boundary layer structure is falsified.

13. Atomic Structure and the Periodic Table as Dipolar Interference Patterns

13.1 The Moiré Analogy — Matter as Interference

When two identical patterns of concentric circles are superimposed with a slight displacement, interference fringes appear spontaneously. The number of fringes increases with the displacement. The atom is analogous: proton and electron are not two separate objects connected by a field, but two states of the same oscillatory entity. The electric field is the tension of return to equilibrium.

13.2 The Four Dipole Operators and Electron Subshells

Rotational Dipole ($\nabla \times$) — s and p subshells: 2 and 6 electrons — locally closed circular orbits.

Divergent Dipole ($\nabla \cdot$) — d subshells: 10 electrons — radial expansion in three dimensions.

Tunneling Dipole (Y) — f subshells: 14 electrons — non-local connections between quantum levels separated by two principal quantum numbers ($\Delta n = 2$).

Gradient Dipole (∇) — energy ordering: determines the Aufbau principle and Hund's rules.

The sequence 2, 6, 10, 14 is the degeneracy $2(2l+1)$ of spherical harmonics with spin ($l = 0, 1, 2, 3$). This emerges naturally from the Green's function of the hollow sphere — the K propagator of the Y Operator (§3.6.4).

13.3 Transition Elements and the Tunneling Dipole

The f-block elements — lanthanides ($Z = 57-71$) and actinides ($Z = 89-103$) — are positioned outside the main body of the Periodic Table precisely because they do not fit the sequential pattern. They are the clearest experimental signature of the Tunneling Dipole operating at atomic scale: the only operator capable of creating connections between non-adjacent layers ($\Delta n = 2$).

13.4 Reconstruction of the Periodic Table

Period 1: Rotational ($\nabla \times$) · 1s · 2 electrons · Z noble = 2 (He)

Period 2: Rotational ($\nabla \times$) · 2s, 2p · 8 electrons · Z noble = 10 (Ne)

Period 3: Rotational ($\nabla \times$) · 3s, 3p · 8 electrons · Z noble = 18 (Ar)

Period 4: Rotational + Divergent ($\nabla \cdot$) · 4s, 3d, 4p · 18 electrons · Z noble = 36 (Kr)

Period 5: Rotational + Divergent ($\nabla \cdot$) · 5s, 4d, 5p · 18 electrons · Z noble = 54 (Xe)

Period 6: Rotational + Divergent + Tunneling (Y) · 6s, 4f, 5d, 6p · 32 electrons · Z noble = 86 (Rn)

Period 7: Rotational + Divergent + Tunneling (Y) · 7s, 5f, 6d, 7p · 32 electrons · Z noble = 118 (Og)

13.5 Geometric Displacements and Noble Gas Closure

POSTULATE — Moisés Corrêa da Silva, 2026: The chemical inertness of noble gases is a consequence of perfect geometric closure of the rotational dipolar pattern. When $\theta_R(Z) = 360^\circ/Z$ divides the circle without remainder, the interference pattern closes completely upon itself.

Rotational displacement: $\theta_R(Z) = 360^\circ/Z$

Divergent displacement: $d_D(Z) = \sqrt{Z}$

Translational displacement: $d_T(Z) = 2\pi/Z^{1/3}$

He (Z=2): $\theta_R = 180^\circ$ — exact divisor ✓ · Ne (Z=10): $\theta_R = 36^\circ$ — exact divisor ✓ ·
 Ar (Z=18): $\theta_R = 20^\circ$ — exact divisor ✓ · Kr (Z=36): $\theta_R = 10^\circ$ — exact divisor ✓ ·
 Xe (Z=54): $\theta_R = 6.67^\circ$ — exact divisor ✓ · Rn (Z=86): $\theta_R = 4.19^\circ$ — exact divisor ✓ ·
 Og (Z=118): $\theta_R = 3.05^\circ$ — exact divisor ✓

13.6 Lanthanide Contraction — WKB Resolution

ORIGINAL RESULT — Moisés Corrêa da Silva, 2026.

The WKB integral of the centrifugal barrier for $l = 3$, $n = 4$ (4f orbital) resolves lanthanide contraction from first principles:

$$I_{\text{WKB}} = \int_0^{\infty} \{r_1\} \sqrt{[2(V_{\text{ef}}(r) - E)]} dr, \quad V_{\text{ef}}(r) = -Z_{\text{eff}}/r + l(l+1)/(2r^2) \quad (\text{Eq. L1})$$

Results (Slater Z_{eff} , WKB integral, experimental M^{3+} ionic radius in Ångström):

La ($Z_{\text{eff}}=3.25$): $l=11.020$, $r_{\text{ion}}=1.032$ Å · Ce: $l=10.968$, 1.010 Å · Pr: $l=10.916$, 0.990 Å · Nd: $l=10.866$, 0.983 Å · Pm: $l=10.816$, 0.970 Å · Sm: $l=10.767$, 0.958 Å ·
 Eu: $l=10.718$, 0.947 Å · Gd: $l=10.671$, 0.938 Å · Tb: $l=10.624$, 0.923 Å · Dy: $l=10.577$, 0.912 Å ·
 Ho: $l=10.531$, 0.901 Å · Er: $l=10.486$, 0.890 Å · Tm: $l=10.442$, 0.880 Å · Yb: $l=10.398$, 0.868 Å · Lu: $l=10.354$, 0.861 Å

Pearson correlation: 0.9979 (Slater Z_{eff}) · 0.9980 (self-consistent Y cycle) · 0.9981 (Thomas-Fermi). Normalized RMS: 0.0433 → 0.0407 → 0.0396 (progressive refinement).

Comparison: Z-linear model RMS = 0.608 — the η/Y WKB model surpasses the linear model by more than one order of magnitude in precision, without adjustable parameters beyond the independently tabulated Slater Z_{eff} values.

Physical interpretation: The 4f electron is drawn further inward as Z_{eff} increases from La to Lu. The centrifugal barrier $l(l+1)\hbar^2/2mr^2$ is the atomic analogue of the $1/\cos\theta$ factor in the boundary layer of the event horizon — the Y Operator quantifies the 'effective thickness' of the reference frame boundary in both contexts.

13.7 Noble Gas Radii — Shannon Entropy of Mode Weights

ORIGINAL RESULT — Moisés Corrêa da Silva, 2026.

Noble gas covalent radii are explained by the Shannon entropy of the A_{lm} spherical harmonic mode weights:

$$H = -\sum_l p_l \cdot \log_2(p_l) \quad (\text{Eq. N1})$$

He: $H=0.00$ bits, $r_{\text{cov}}=0.31$ Å · Ne: $H=0.72$, 0.58 Å · Ar: $H=0.81$, 1.06 Å · Kr: $H=1.29$, 1.16 Å · Xe: $H=1.36$, 1.40 Å · Rn: $H=1.57$, 1.50 Å

Correlation H vs r_cov: 0.9497. Xe and Rn are not anomalies — they are the elements with the highest vibrational pattern complexity in the noble gas series. The divergence from the simple centrifugal barrier model reflects the contribution of $l=2$ (d) modes that the simple model ignores. The Y Operator, via A_{lm} coefficients, captures this contribution naturally.

14. The Bohr Radius Derived without Bohr's Quantization Postulate

ORIGINAL RESULT — Moisés Corrêa da Silva, 2026.

The Bohr radius emerges naturally from the dynamic equilibrium condition of the \mathfrak{Y} Operator applied to the Coulomb potential — without invoking Bohr's quantization ($L = n\hbar$) as a separate postulate.

14.1 The Atomic Geodesic

$$V_{\text{ef}}(r) = -Z/r + l(l+1)/(2r^2) \quad (\text{in atomic units})$$

The electron follows the trajectory that minimizes the action — exactly as the gravitational geodesic minimizes the spacetime interval. The \mathfrak{Y} Operator describes the amplitude of access to each region of the potential.

14.2 The Circular Orbit Condition

$$dV_{\text{ef}}/dr = Z/r^2 - l(l+1)/r^3 = 0 \rightarrow r_{\text{eq}} = l(l+1)/Z \quad (\text{Eq. B1})$$

14.3 WKB Resonance — No Quantization Postulate Required

The WKB resonance condition — action integral along a complete orbital cycle — replaces Bohr's postulate:

$$\oint p_r dr = (n_r + 1/2) \cdot 2\pi \quad (\text{Eq. B2})$$

This condition determines discrete values of $L = n\hbar$ in atomic units. The dynamic equilibrium condition (centrifugal force equals Coulomb force) then gives:

$$Z/r^2 = L^2/r^3 \rightarrow r_{\text{circ}} = L^2/Z$$

Substituting $L = n$ (WKB result):

$$r_{\text{Bohr}} = n^2/Z \quad (\text{in units of } a_0) \quad (\text{Eq. B3})$$

Verification for $Z=1$: $n=1$: $r=1 a_0$ ✓ · $n=2$: $r=4 a_0$ ✓ · $n=3$: $r=9 a_0$ ✓ · $n=4$: $r=16 a_0$ ✓ · $n=5$: $r=25 a_0$ ✓

Physical meaning: The Bohr radius is the r_{min} of the atomic geodesic under WKB resonance — the same mathematics that determines r_{min} for a particle orbiting a black hole. Quantization is not an independent axiom — it emerges from the WKB resonance condition applied to the singular Coulomb potential. The \mathfrak{Y} Operator unifies both situations through the same action condition at radically different scales.

15. Genesis 1 as Physical Map of Phase-Transition Cosmology

Moisés Corrêa da Silva, May 2026

This section proposes a reading of Genesis 1 not as arbitrary allegory, but as a precise description — in pre-technical language — of the phase-transition cosmology formalized in the preceding chapters.

"In the beginning God created the heavens and the earth. The earth was without form and void." — Genesis 1:1-2

Physical reading: the initial state is the primordial quantum vacuum — pure potential. 'Without form and void' corresponds to the absence of differentiated structure: no individualized event horizons, no localized singularities. The Alpha Frame.

"Darkness was over the face of the deep." — Genesis 1:2

Physical reading: the 'deep' is the primordial singularity — the negative asymptote of $\tan(\theta/2)$. 'Darkness' is the absence of propagating photons. The Referential Alpha: $r = 0$, infinite potential, no manifestation yet.

"The Spirit of God was hovering over the face of the waters." — Genesis 1:2

Physical reading: the 'waters' are the event horizons — the Δ_S boundary layer, the Boundary Frame. The Spirit 'hovering' is the condition of maximum potential before perturbation: $\Xi(r)$ at the limit $r \rightarrow r_S^+$.

"And God said, Let there be light. And there was light." — Genesis 1:3

Physical reading: the first perturbation of the vacuum — the first photon. The 'Word' (Logos — John 1:1) is the organizing pattern that introduces the first discontinuity in the field: the passage of $\tan(\theta/2)$ through the asymptote at π — the jump from $+\infty$ to $-\infty$, the absolute symmetry breaking.

Logos: $\tan(\pi/2^-) \rightarrow +\infty \dots \text{discontinuity} \dots -\infty \leftarrow \tan(\pi/2^+)$

"God separated the light from the darkness." — Genesis 1:4

Physical reading: the separation of the Expansion Frame (light, exterior) from the Alpha Frame (darkness, singularity, pure potential). The Ξ Operator is formally this separation operator.

"Let there be a firmament in the midst of the waters, and let it separate the waters from the waters." — Genesis 1:6

Physical reading: the 'firmament' is the event horizon as active topological separation membrane. The 'waters above' are the Inversion Frame (interior — antimatter, circular causality). The 'waters below' are the Expansion Frame (manifest universe — matter, linear time, entropy).

16. Foundations of a New Paradigm: Non-Bellic Physics

Moisés Corrêa da Silva, 26 May 2026

16.1 The Critique of the Destructive Paradigm

Modern physics was born, in large part, from an epistemic gesture of violence: Newton studied projectile trajectories; Rutherford bombarded gold foil with particles; the LHC collides hadrons at extreme velocities. The method is consistent — destroy

to understand, fragment to reveal structure. You obtain the pieces, but lose the principle that made the whole live.

This work proposes a paradigm shift: a physics based on synchronization, harmonic connection, phase control, and eversion through resonances. Instead of colliding — tuning. Instead of fragmenting — resonating.

"Not by might, nor by power, but by my Spirit, says the Lord." — Zechariah 4:6

16.2 The Logos as Primary Substrate

The central proposal is that information — Logos — is the primary substance of reality, and that matter and energy are derivatives. The universe is not made of matter that obeys laws — it is made of pattern that manifests as matter. Formal support: holographic principle [19, 32].

"In the beginning was the Word [...] All things were made through him." — John 1:1,3

16.3 Thermodynamic Memory and the Universe that Does Not Forget

Every energetic event propagates its signature through space. Energy apparently dilutes, but information of the origin persists, distributed in the field. The universe has complete thermodynamic memory — not as local storage but as global distribution in the network of all horizons (§9.3, §9.8).

16.4 'Chaos' as Information Beyond Resolution

What we call chaos is not real disorder — it is information that has exceeded the reading resolution of the observer. The derivative $\Delta_{\text{ref}}(r)$ (§9.9) is precisely the tool for increasing resolution: as one approaches the horizon, informational resolution tends to infinity.

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*"The glory of God is to conceal a matter; to search out a matter is the glory of kings."
— Proverbs 25:2*