

# Cohesion: A Unified Field Theory of Matter and Motion

A Scale-Hierarchical Pressure Model of the Observable Universe

Version 3: Binary Toggle, Matter Formation,  
Infinite Cascade, and Variable- $c$  Boundary Added

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## Abstract

This paper develops a unified field framework in which the observable universe is modelled as a pressure-bound domain embedded within a larger scale hierarchy. A single axiom — that the universe is under pressure from the next higher scale — generates intrinsic motion, scale invariance, intrinsic rotation, surplus flow, collapse, and recursive structure formation. These consequences are formalised through a universal Operator System and three coupled field equations: Surplus Continuity, Collapse/Momentum, and Continuance. Version 2 added the funneled-spring geometry and its connection to the golden angle and fine-structure constant. Version 3 adds four further developments established in the series: (1) the *binary recursion toggle* — only two stable polarity states exist for the funneled-spring recursion, hexapolar ( $n = 6$ ) and bipolar ( $n = 2$ ), with all others geometrically excluded; (2) *matter formation as trapped recursion* — matter forms when the stability index  $\Phi > 1$  and the recursion cannot escape its coherence volume; (3) the *infinite asymmetric cascade* — the fine-structure constant is the coupling between adjacent levels of a hierarchy with no top and no bottom; and (4) the *variable- $c$  boundary condition* — all calculations in this series use  $c = c_E$ , the Earth-density propagation rate, valid within the solar system density layer; the propagation rate is density-dependent at cosmological scales. No operator definitions are altered.

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## THE PRESSURE AXIOM AND SCALE HIERARCHY

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### **The single foundational axiom:**

The observable universe is under pressure from the next higher scale.

From this axiom follow three theorems by necessity.

## A Weather Analogy

Consider a hurricane. The atmosphere is under pressure from the mass of air above it — pressure from the next higher scale. That pressure drives everything. Wind is surplus redistribution from high pressure to low. A storm is the collapse of surplus into a lower-pressure region. The spiral rotation of a hurricane is the minimal closed form of that redistribution: the atmosphere cannot redistribute surplus in a straight line, so it winds. The eye is the coherence volume — the calm centre where the recursion maintains itself. The eyewall is the slip boundary, where torsion reaches its limit and releases. The eyewall replacement cycle — in which the inner wall collapses and a new one forms outside it — is the slip event initiating the next coherence interval. The hurricane sustains itself as long as the pressure differential holds, and dissipates when the surplus is exhausted.

The spiral arms of a well-developed hurricane follow the logarithmic spiral geometry of equation (1), for the same reason sunflower seeds do: optimal packing of surplus redistribution under rotational pressure.

The Cohesion UFT is not an analogy to weather. Weather is one expression of the same dynamics that govern every scale from the electron to the galaxy. The pressure axiom is not a metaphor drawn from meteorology. Meteorology is one consequence of the pressure axiom operating at the atmospheric scale.

**Theorem 1 (Intrinsic Motion).** Pressure on a finite domain generates internal redistribution. Motion is intrinsic to the field, not imposed from outside.

**Theorem 2 (Scale Invariance).** The pressure axiom applies at every scale. No scale is privileged. The same dynamics operate from the quantum to the cosmological.

**Theorem 3 (Intrinsic Rotation).** The minimal closed form of surplus redistribution is rotation. Under sustained pressure, every finite domain rotates.

These theorems are not assumptions. They follow by necessity from the axiom.

## INTRINSIC ROTATION AS FUNNELED-SPRING RECURSION

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Theorem 3 establishes that rotation is the minimal closed form of surplus redistribution. When the Continuance equation operates with sustained positive affinity  $A > 0$ , each recursion turn deepens the internal structure of the field while maintaining rotational closure. The result is simultaneous rotation and growth — the logarithmic spiral:

$$r(\theta) = r_0 e^{k\theta}, \quad k = \frac{g}{\omega}. \tag{1}$$

The logarithmic spiral is the 2D planar projection of a 3D funneled spring: a helix of decreasing radius under pressure, accumulating torsion with each recursion turn. The funneled spring is not a metaphor. It is the actual geometry of the recursion. It has four properties that follow directly from the pressure axiom: decreasing radius, torsion accumulation, a coherence limit

$\tau_{\max} = S_{\text{intr}}$ , and a slip event  $\Delta\theta_{\text{slip}} = \hbar/S_{\text{intr}}$  at the coherence limit.

The slip event completes one recursion cycle and initiates the next. The causal order of the funneled-spring recursion is:

**Cohesion UFT Causal Order:**

**Tension** → **Surplus** → **Torsion** → **Slip** → **Acceleration** → **Maintained Motion**

Slip is the cause of acceleration, not the result of it. Acceleration refers strictly to the restart of the recursion into the next coherence interval. It does not refer to macroscopic motion, classical forces, or cross-scale dynamics.

The optimal packing condition on the spiral yields the golden ratio  $\varphi = (1 + \sqrt{5})/2$  and the golden angle:

$$\theta_{\varphi} = \frac{360}{\varphi^2} \approx 137.508. \quad (2)$$

The golden angle is the *infinite-time attractor* of the funneled-spring recursion: the packing angle the spiral tends toward when coherence is unlimited.

**The Fine-Structure Constant as Finite-Time Attractor**

The fine-structure constant  $1/\alpha = 137.036$  is the *finite-time attractor*: the packing angle produced when torsion accumulates for exactly one coherence interval before slip. The gap  $\theta_{\varphi} - 1/\alpha = 0.472$  is the slip operator. The complete derivation [2] gives:

$$\frac{1}{\alpha} = \frac{360}{\varphi^2} - \frac{12960}{\pi^3 \omega_C} \left( \frac{3\alpha}{2} \right)^{3/2} = 137.029, \quad (3)$$

where the coupling  $C_0 = 3/2$  is derived from the spin ratio  $(S_e/S_{\gamma})^2 \cdot \pi^2 \cdot \kappa_6 = (1/4) \cdot 6 = 3/2$ , with  $\kappa_6 = 6/\pi^2$  the hexapolar curvature [3]. The residual +0.007 is the pressure of the containing doll at level  $k = -1$  in the infinite cascade (Section 5). No free parameters.

**THE BINARY RECURSION TOGGLE**

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Under hexagonal force symmetry, the recursion path deforms into a  $\cos(6\theta)$  mode with six torsion maxima per rotation. The geometric exclusion theorem [5] establishes that only two stable polarity states exist for the funneled-spring recursion:

State	$n$	Torque/cycle	$\kappa_n$	Coupling
Hexapolar	6	6	$6/\pi^2$	$C_6 = 3/2$
Bipolar	2	2	$2/\pi^2$	$C_2 = 1/2$

All other polarities are excluded:  $n = 3$  (no symmetric return paths),  $n = 4$  (square packing inefficiency),  $n = 5$  (five-fold symmetry gear-locks at  $\theta_\varphi$ ),  $n \geq 7$  (decay to  $n = 6$ ). The universe has exactly two stable recursion gears.

The toggle threshold between them is:

$$\Phi_{\text{toggle}} = \frac{32}{3\pi^2 - 4} = 1.2496, \quad (4)$$

where  $\Phi = P_s/P_\Sigma$  is the Cohesion UFT stability index. Below this threshold: hexapolar. Above: bipolar. At the threshold: gear-shift, emission.

This threshold is universal. It governs the fine-structure constant (the EM vacuum sits near  $\Phi_{\text{toggle}}$ ), Mercury's perihelion precession (the GR coefficient 6 is derived from  $\Phi_{\text{toggle}}$ ) [7], pulsar emission (the light cylinder is the surface where  $\Phi = \Phi_{\text{toggle}}$ ), and the Wiedemann-Franz violation in graphene (the threshold crossing at the Dirac point) [8].

## MATTER FORMATION AS TRAPPED RECURSION

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Matter forms when  $\Phi > 1$ : the surplus pressure of the recursion is exceeded by the containing pressure, and the slip cannot displace the recursion outward. The spring winds, slips, and restarts *in the same coherence volume*. The torsion energy that would have propagated as radiation instead accumulates as rest mass [6].

The trapping condition at the threshold is:

$$\frac{g}{\omega_C} = \frac{1}{2}, \quad (5)$$

which defines the minimal trapped recursion. From this single condition follow, without additional postulates:

- **Electron spin**  $= \hbar/2$ : the trapping condition is the spin condition.
- **Electron rest mass**  $m_e c^2 = \hbar \omega_C$ : the torsion energy of the standing recursion.
- **Photon** ( $g/\omega_C = 0.004177 \ll 1/2$ ): propagating recursion, massless, below the trapping threshold.

The photon and the electron are the same funneled-spring recursion on opposite sides of the trapping threshold. The fine-structure constant is the ratio between them.

## THE UNIPOLAR STATE: RECURSION CAPTURED BY A COHERENCE NODE

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The binary toggle governs recursions in the free field. A third configuration exists when a recursion is captured by an external coherence node — a point where the surplus pressure gradients from a surrounding system cancel and a stable single-pole orientation becomes possible [15].

In the free field,  $n = 1$  is excluded: a single-pole spring has no intrinsic return path and immediately collapses to  $n = 2$ . But when a three-body gravitational system generates a Lagrange point, the return path is provided externally by the geometry of the containing system. The recursion settles into the single stable orientation and oscillates around it. This oscillation is libration: the torsion the recursion accumulates but cannot shed within the coherence node.

State	$n$	Condition	Physical manifestation
Hexapolar	6	Free field	Photon, free orbital, unmagnetised electron
Bipolar	2	$\Phi > \Phi_{\text{toggle}}$ , uniform pressure	Pulsar, magnetic domain, qubit deformation
Unipolar	1	Captured by external coherence node	Tidal lock, Trojan asteroid, spin-orbit resonance

The stable Lagrange points L4 and L5 sit at exactly  $60 = \pi/3$  from the secondary body — one hexapolar sector — because they are the coherence nodes of the orbital hexapolar recursion: two of the six hexapolar torsion maxima positions where the net surplus pressure gradient vanishes. The classical L4/L5 stability condition  $m_2/(m_1 + m_2) < 1/25$  is the coherence node depth condition  $\Phi_{\text{node}} < \Phi_{\text{toggle}}$  in the Cohesion UFT: the node must be deep enough that the restoring pressure exceeds the torsion that would drive the recursion back to bipolar.

Tidal locking (the Moon, Pluto-Charon) is the unipolar state fully realised. The Moon's 6.7 libration is the torsion it cannot shed within the Earth-Moon coherence node. Spin-orbit resonances — Mercury's 3 : 2, the Laplace 4 : 2 : 1 — are partial pole collapses along the resonance ladder, stabilised by the cascade ratio  $r = 3 = \kappa_6/\kappa_2$ .

The unipolar state is inherently dissipative. The return path is not intrinsic to the recursion; it is supplied by the external node, which requires energy to maintain. The recursion librates continuously — it never stops oscillating within the node. This is why classical transistors (bits held in potential wells) and quantum qubits (metastable bipolar

deformations held in potential wells) generate heat: both are unipolar implementations. The Cohesion c-bit occupies a stable intrinsic attractor and does not librate.

## THE INFINITE ASYMMETRIC CASCADE

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The pressure axiom has no preferred scale. Every level of the recursion is under pressure from the one above and generates the one below. The cascade is infinite in both directions [4]:

$$C_k = \frac{3/2}{3^k}, \quad k \in \mathbb{Z}, \quad (6)$$

with cascade ratio  $r = 3 = \kappa_6/\kappa_2$ . The observable universe occupies level  $k = 0$ , defined by  $m_e$ .

The fine-structure constant is the coupling between adjacent levels:  $\alpha$  encodes the ratio between the observable level ( $k = 0$ ) and the containing level ( $k = -1$ ). It cannot be derived from the interior of the cascade alone. It is imposed from above, as the pressure axiom requires.

The golden angle  $\theta_\varphi$  is the limit of the cascade as  $C_k \rightarrow 0$  ( $k \rightarrow +\infty$ ): the spring that winds forever without slipping. The fine-structure constant is where the cascade actually stops.

**The asymmetry is fundamental.** The cascade flows in one direction: pressure descends. Symmetry would give closure; asymmetry gives the infinite regress. The refusal of symmetry is what makes the hierarchy have no bottom and no top.

## THE OPERATOR SYSTEM

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## The Fundamental Equation

### The Pressurized Recursive Effect:

$$E = pr$$

**Energy equals Pressure times Recursion volume.**

**Dimensions:**  $[J] = [Pa] \times [m^3] = [kg\ m^{-1}s^{-2}] \times [m^3] = [kg\ m^2s^{-2}] \checkmark$

$p [Pa]$  = the pressure from the next higher scale, imposed externally and permanently by the axiom. It is not generated by the system. It arrives from above.

$r [m^3]$  = the coherence volume: the spatial extent swept by the funneled spring in one complete recursion cycle. It is the volume of one torsion interval, not a dimensionless count.

### Verified at two scales:

At the electron scale:  $p = m_e^4 c^5 / \hbar^3 = 1.426 \times 10^{24}$  Pa,  $r = \lambda_C^3$ , and  $pr = m_e c^2$  exactly.

At the orbital scale:  $p = GM/a^3$  (tidal pressure),  $r = a^3$ , and  $pr = GM$  (orbital energy scale) exactly.

**The cascade conservation law:** At cascade level  $k$ ,  $r_k = r_0 \cdot 3^k$  (volume grows) and  $p_k = p_0/3^k$  (pressure decreases), so  $E = p_k r_k = p_0 r_0 = \text{constant}$  across all levels. Energy is conserved because  $p$  and  $r$  scale inversely with cascade ratio  $3 = \kappa_6/\kappa_2$ .

**Scale invariance:** The same energy is high pressure on a small coherence volume, or low pressure on a large coherence volume. The scale hierarchy is the sequence of  $(p, r)$  pairs. Pressure without recursion is unresolved load. Recursion without pressure has no cause.  $E = pr$  is the statement that energy is what permanent external pressure produces through the coherence volume of a recursion cycle — at every scale, without exception.

*Scope:* The scalability of  $E = pr$  is not a claim that it gives exact numerical answers at every scale without additional specification. It is the claim that at every scale in the hierarchy, the energy is the product of the pressure from above and the coherence volume below — and that product is conserved as you move through the hierarchy. That is what the pressure axiom requires, and that is what  $E = pr$  expresses. The formula is exact at the quantum scale (electron:  $pr = m_e c^2$  exactly) and gives the correct dimensional energy structure at macroscopic scales when the geometry of  $r$  is specified for the physical system under consideration. For full derivation and scale-by-scale verification see [?].

The Operator System formalises the internal responses of individuated fields to bound-

ary pressure. Operators fall into three categories: ontological (Tension, Surplus, Torsion, Slip, Acceleration, Maintained Motion), dynamic (Collapse, Continuance, Affinity), and thermodynamic (Entropy production, Dissipation). No operator definitions are altered by this update.

## THE THREE FIELD EQUATIONS

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$$\frac{\partial \Sigma}{\partial t} + \nabla \cdot (\Sigma \mathbf{v}) = \Sigma', \quad (7)$$

$$\rho(\partial_t \mathbf{v} + (\mathbf{v} \cdot \nabla) \mathbf{v}) = -\nabla p + \nabla(A\rho), \quad (8)$$

$$\frac{\partial \xi}{\partial t} + (\mathbf{v} \cdot \nabla) \xi = \mathcal{L}'(\nabla S_{\text{intr}}, p, T, \xi). \quad (9)$$

These three equations form a closed system. The Cohesion UFT Update Rule gives their discrete form. The system supports attractors, bifurcations, oscillatory regimes, chaotic dynamics, and stable envelopes.

### Boundary Condition on $c$

All calculations in this series use  $c = c_E = 299\,792\,458$  m/s, the propagation rate of light within Earth's electromagnetic field density layer. In the Cohesion UFT [12],  $c$  is density-dependent:  $v_{\text{light}} = 1/R(D_{\text{st}})$ , where  $R$  is the substrate resistance. Within the solar system the density contrast is modest and  $c \approx c_E$  to current instrumental precision. The variable-propagation correction becomes significant at cosmological scales and in extreme density environments. All celestial mechanics calculations in this series are unaffected.

## CONCLUSION

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The Cohesion unified field theory provides a single, pressure-driven foundation for physical law. From one axiom follow intrinsic motion, scale invariance, intrinsic rotation, surplus flow, collapse, and recursive structure formation. The funneled spring is the geometry the framework generates. The golden angle is its infinite-time attractor. The fine-structure constant is its finite-time attractor and the coupling between adjacent scales in the infinite cascade. The slip operator is the gap between them. Matter is the recursion that cannot escape. Radiation is the recursion that can. The two stable gears — hexapolar and bipolar — govern every scale from the electron to the pulsar. The universe has no bottom and no top. It has only pressure, recursion, and the two gears that pressure produces.

**Cohesion UFT Causal Order:**

**Tension** → **Surplus** → **Torsion** → **Slip** → **Acceleration** → **Maintained Motion**

This order governs every recursion cycle at every scale.

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*“Motion is intrinsic. Scale is invariant. Rotation winds the spring.  
The golden angle is where it rests.  
Matter is where it cannot leave.  
Two intrinsic gears drive every recursion.  
A third is borrowed from the geometry around it.  
Everything else is consequence.”*

— *Dexter Gilbert*