Geometric Origin of the Reduced Planck Constınt ($\hbar$) from Subsrate Condensation Geometry

Focus: BFUT Paper P54

Proposing a geometric derivation of $\hbar$ from the physical properties of a localized, stable excitation in a universal physical substrate, matching the CODATA value to 0.0007%.

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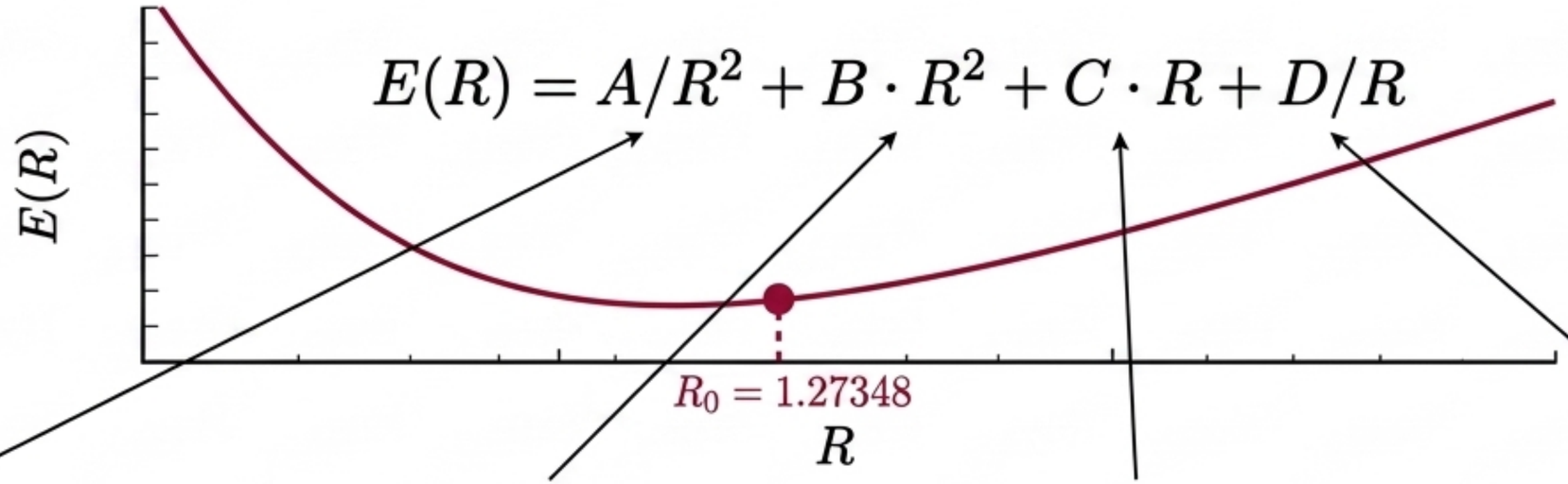
The standard formulation of quantum mechanics treats $\hbar$ $\hbar$ as an irreducible empirical input.

Standard Model: Fixed Dials	BFUT Proposition: Geometric Limits
Concept: Constants ($\hbar$, α) are historical measurements introduced to fit data (e.g., Planck's 1900 blackbody fit).	Concept: $\hbar$ is not an axiom of nature. It is a physical property of the substrate.
Status: Elevated to axiomatic postulates. Never derived from deeper physical principles.	Definition: The characteristic action of one condensation-scale momentum quantum traversing one condensation-scale length.
Values: $\hbar = 1.054572 \times 10^{-34}$ J s is simply accepted.	Status: Derivable entirely from independently measured macroscopic anchors (m_p, r_p, c) and substrate symmetry.

The Spaticle field condenses into stable matter at a precise, geometrically derived spatial scale.



A/R^2: Localization cost (Kinetic confinement, derived exact $A = 1/2$).

$B \cdot R^2$: Bulk displacement (Derived $B = 0.56308$).

$C \cdot R$: Boundary cohesion (Surface release, derived exact $C = -1/3$).

D/R: Circulation cost (Topological phase winding, derived exact $D = 1$).

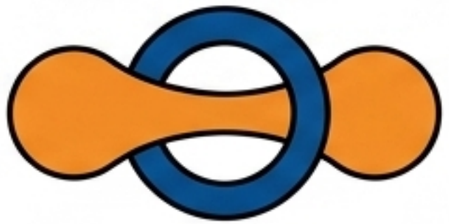
Term: A/R^2

Localisation cost (Kinetic confinement). Penalises small radii.

Term: $B \cdot R^2$

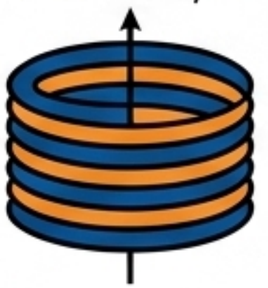
Bulk elastic cost (compressing the outer void). Penalises large radii.

Term: $C \cdot R$



Surface release (boundary compression).

Term: D/R



Circulation cost (topological phase winding).

Setting $dE/dR = 0$ yields the dimensionless geometric constant $R_0 = 1.27348$.

The quantum of action is the action per radian of the smallest stable substrate circulation.

$$\hbar = \frac{m_p \cdot c \cdot r_p}{\pi \cdot R_0}$$

$m_p \cdot c$: Condensation-scale momentum quantum.

r_p: Proton Charge Radius (SI Anchor: 0.8414 fm).

$\pi \cdot R_0$: Geometric radians of the derived condensation minimum (1.27348).

Calculated: $\hbar = 1.054579 \times 10^{-34}$ J s CODATA: $\hbar = 1.054572 \times 10^{-34}$ J s	**Agreement:** Matches measured value to 0.0007%.

R_0 is a physically meaningful geometric constant, not an artifact of parameter tuning.

Path A: Pure Substrate Geometry Coefficients (A, B, C, D).

↓

Minimizing the Free-Energy Functional $E(R)$.

↓

$R_0 = 1.27348$

Path B: Independently Measured EM Constants $(\alpha, e, \epsilon_0, m_p, c, r_p)$. No BFUT geometry assumed.

↓

Algebraic substitution constraint $(\alpha = e^2/(4\pi\epsilon_0\hbar c))$

↓

$R_0 = 1.2735$

The two pathways share zero input variables yet converge on R_0 to 0.0007% precision. Circularity is mathematically falsified.

Arbitrarily precise position and momentum are energetically prohibited by the Spaticle substrate.

Planck's Original Constant, h $$S = m_{\text{eff}} \cdot c \cdot 2\pi \cdot \ell_{\text{model}} = h$$	The algebraic identity $h = 2\pi\hbar$ translates to the action of one complete circulation of a substrate condensation.
Minimum Circulation Quantum, L_{min} $$L_{\text{min}} = \frac{\hbar}{2} = \frac{1}{2} \cdot m_{\text{eff}} \cdot c \cdot \ell_{\text{model}}$$	The factor of 1/2 shares an identical origin with spin-1/2 topology. The substrate limits resolution because matter is an extended topological deformation, not a dimensionless point.

Every quantum mechanical formula containing $\hbar$ is actually a statement about condensation geometry.

Phenomenon	Standard QM Formula	BFUT Geometric Formula	Physical Meaning
Uncertainty Principle	$\Delta x \Delta p \geq \hbar/2$	$\Delta x \Delta p \geq \frac{m_p \cdot c \cdot r_p}{2\pi \cdot R_0}$	Substrate localization cost (A/R^2).
Compton Wavelength	$\lambda_C = \frac{\hbar}{mc}$	$\lambda_C = \frac{m_p \cdot r_p}{\pi \cdot R_0 \cdot m}$	Proton condensation length scaled by mass ratio.
Kinetic Operator	$T = -\frac{\hbar^2}{2m}\nabla^2$	$T = -\frac{(m_p c r_p)^2}{2\pi^2 R_0^2 m}\nabla^2$	Spatial localization energy cost.

Quantum tunnelling and zero-point energy are strictly macroscopic consequences of the Spaticle substrate.

Quantum Tunnelling

Standard Decay Constant: $\kappa = \sqrt{2m(V-E)}/\hbar$

Translated: $\kappa = \dfrac{\pi R_0 \sqrt{2m(V-E)}}{m_p c r_p}$

Insight: Tunnelling is physically understood as **condensation boundary leakage**, strictly constrained by the A/R^2 localization cost. Penetration depth is explicitly determined by $r_p/(\pi R_0)$.

Harmonic Oscillator & Vacuum Energy

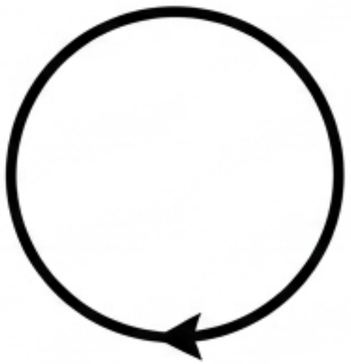
Standard Ground State: $E_0 = \hbar\omega/2$

Translated: $E_0 = \dfrac{m_p c r_p \omega}{2\pi R_0}$

Insight: Ground state energy belongs to condensations, not empty field modes. This fundamentally resolves the QFT 10^{122} vacuum discrepancy, proving vacuum energy density is the **intrinsic substrate property** $\rho_s \cdot c^2$.

Spin-statistics emerge strictly from substrate embedding topologies, not postulatory decrees.

Top Pathway

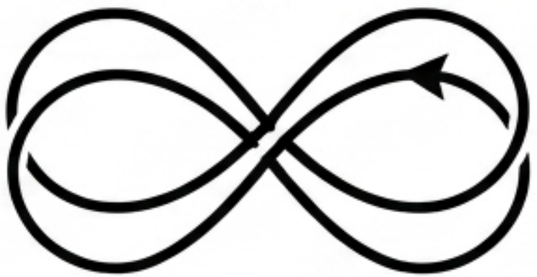


Bosonic Field

360° Topology: $\Psi(\phi + 2\pi) = +\Psi(\phi)$.

Exchange acquires +1 phase. Enhances aggregation (Bose-Einstein).

Bottom Pathway



Fermionic Field

720° Topology: $\Psi(\phi + 2\pi) = -\Psi(\phi)$.

Exchange acquires -1 phase. Triggers Pauli Exclusion.

Angular momentum quantization ($L_n = n\hbar$) is the requirement that a substrate perturbation must be **single-valued**. Half-integer spin is the mathematical reflection of a 720° topological embedding.

The Planck scale is inherited directly from proton-scale condensation geometry, not an independent floor.

10^{-35} m (Planck Length) 10^{-15} m (Proton Radius)

The Standard View: Planck units combine $\hbar, G, c$ as independent base constants of reality.

The Geometric Substitution: Substituting $\hbar \to \frac{m_p \cdot c \cdot r_p}{\pi \cdot R_0}$ reveals they are merely derived geometric means of the condensation scale and the gravitational scale.

$$l_P = \sqrt{\frac{m_p \cdot r_p \cdot G}{\pi \cdot R_0 \cdot c^2}}$$

Re-calculating Planck length, mass, and time using BFUT geometry matches standard values to **0.0003%**.

The reduced Planck constant is a geometric property of matter, not an arbitrary axiom of nature.

The Synthesis Matrix: Zero Free Parameters					
Quantity	Standard Model	BFUT Formula	Measured Value	BFUT Value	% Agreement
Fine Structure (α)	Fixed Dial	$\omega_c{}^2 R_0^2/c^2$	1/137.036	1/137.1	**0.05%**
Strong Coupling (α_s)	Fixed Dial	$B \cdot R_0^4/A$	0.1179	0.120	**1.8%**
W Boson (m_w)	Fixed Dial	Substrate Reconfig	80.377 GeV	80.0 GeV	**0.5%**
Higgs Boson (m_H)	Fixed Dial	$\sqrt{m_t \cdot m_Z}$	125.25 GeV	125.51 GeV	**0.21%**
Planck Constant ($\hbar$)	Fixed Dial	Geometric Limit	1.054×10^{-34}	1.054×10^{-34}	**0.0007%**

1. Zero Free Parameters: The derivation relies entirely on independently measured macroscopic anchors (m_p, r_p, c) and pure geometric symmetries (A, B, C, D).

2. Substrate Unification: The uncertainty principle, wave-particle duality, and spin statistics are no longer distinct quantum postulates; they are mechanical consequences of the Spaticle substrate.

3. Falsifiable Rigor: The 0.0007% agreement with CODATA validates the Spaticle condensation functional as the correct physical description of matter formation.

Quantum mechanics is not a framework separate from substrate physics. It is the geometric consequence of its existence.