DISSOLVING THE COSMOLOGICAL CONSTANT PROBLEM:

The Spaticle Substrate, One Quantum Field, and the Category Error of QFT Vacuum Energy

Vijay Shankar Sharma

Independent Researcher, Gurugram, National Capital Region, India

ORCID: 0009-0001-9622-6121 | vss@vijayshankarsharma.com Website : vijayshankarsharma.com

The author declares no conflicts of interest. No external funding was received.

Abstract

The cosmological constant problem is described as the largest quantitative discrepancy in the history of physics: quantum field theory predicts a vacuum energy density of order 10^111 J/m3 while the observed value is of order 10^-10 J/m3, a discrepancy of 10^121. This paper demonstrates that the discrepancy is not a crisis of nature. It is the compounded result of two specific category errors in the standard QFT calculation, errors that disappear once the physical substrate of space is correctly identified.

The first error is multiplicity. Standard QFT assigns independent zero-point energy to each of seventeen or more independent quantum fields, one per particle species. The Big Flare-Up Theory (BFUT) has one field: the Spaticle field. All particles, all force carriers, and all quantum phenomena are organised excitations of that one substrate. Summing over seventeen fields where there is one inflates the vacuum energy calculation by the field count before any other consideration.

The second error is attribution. Standard QFT assigns ground-state energy hw/2 to every field mode regardless of whether that mode contains a physical excitation: an organised, stable condensation. In BFUT, zero-point energy is the minimum internal circulation energy of an actual condensation oscillating at frequency w. An empty mode, one containing no condensation, has no internal circulation and therefore no ground-state energy. The calculation attributes real energy to vast numbers of phantom condensations that do not exist.

Correcting both errors: one field, zero-point energy only for occupied modes. The vacuum is the Spaticle substrate at its intrinsic equilibrium density rho_s = 5.9 x 10^-27 kg/m3, containing no condensations. Its energy density is rho_s * c2 = 5.30 x 10^-10 J/m3. The 10^121 discrepancy dissolves: not by cancellation, not by tuning, not by anthropic selection, but because the calculation was not computing the physical vacuum energy of the universe at all.

A central result of this paper concerns the relation between the Spaticle field density and the cosmological constant Lambda. The Spaticle field has an intrinsic equilibrium density rho_s constrained independently from W and Z boson masses, 175 SPARC galaxy rotation curves, KiDS-1000 weak gravitational lensing, and hydrogen atomic stability across five independent physical sectors. The observed value of Lambda is consistent with rho_s, reflecting that both describe the same physical reality, but rho_s is not derived from Lambda. Lambda is what it is because of rho_s, not the other way around.

The paper also establishes the correct dissolution of the coincidence problem: matter and the Spaticle substrate are not ontologically unrelated quantities whose comparable magnitudes require explanation. Matter is the condensed phase of the substrate. Their broad magnitude comparability is structurally expected.

Keywords: cosmological constant problem, vacuum energy, Spaticle field, zero-point energy, BFUT, substrate density, quantum field theory, dark energy, coincidence problem

---

1. Introduction

The cosmological constant has been one of the most misread symbols in modern cosmology. Einstein introduced Lambda because his equations indicated that the structure of the universe could not be understood without an additional term. Later cosmology repurposed that term as dark energy, a hypothetical dynamical component invoked to explain accelerated expansion. The Big Flare-Up Theory rejects that interpretation. BFUT does not remove Lambda from Einstein's equations. It removes the mistaken interpretation of Lambda.

That distinction has consequences. Once dark energy is identified as an unnecessary interpretive addition, Lambda does not disappear. It remains in the equations as a real term. A serious theory cannot reject the standard interpretation and leave the surviving term conceptually empty. This paper establishes what Lambda physically represents and, equally importantly, corrects the direction of the identification.

This paper therefore serves three purposes. First, it corrects the directional framing of the Lambda, rho_s relationship that appeared in the early BFUT cosmology papers: the direction runs from rho_s to Lambda, not from Lambda to rho_s. Second, it provides the complete diagnosis of why the QFT vacuum energy calculation produces a number 10^121 times too large, a diagnosis that requires identifying two specific errors instead of one. Third, it dissolves both the cosmological constant problem and the coincidence problem from first principles, without cancellation and without new physics.

The paper proceeds as follows. Section 2 states the BFUT premises on which this paper builds. Section 3 establishes the primary BFUT identity of Lambda as the mathematical signature of spatial infinitude. Section 4 explains why dark energy becomes unnecessary while Lambda persists. Section 5 presents the necessity chain. Section 6 states the correct physical identity of rho_s and its relation to Lambda. Section 7 presents the two-error diagnosis of the QFT vacuum energy calculation and the dissolution of the 10^121 problem. Section 9 addresses Einstein's cosmological constant. Section 10 positions the paper within the BFUT programme. Section 11 concludes.

2. BFUT Premises Already Established

This paper is a consequence paper within the BFUT research programme. Its conclusions depend on premises established in the main BFUT paper and companion papers. Those premises are stated explicitly here so the logic of the present paper remains narrow and exact.

The following are the established BFUT starting points for this paper:

> *The universe is infinite in extent and eternal in duration. Space has no boundary and no unique global centre.*
>
> *Dark energy is unnecessary as a physical explanatory entity.*
>
> *The Hubble relation does not compel universal expansion as its only interpretation.*
>
> *Apparent accelerating expansion can be reinterpreted without invoking a dark energy fluid.*
>
> *Space-time is physically real and is constituted by the Spaticle field, an inference supported independently by General Relativity, QFT, the confirmed Higgs field, and the repeated logical convergence of the BFUT research programme.*
>
> *Matter is not ontologically independent of the substrate. It arises as stable, persistent condensed structure within the Spaticle field through the 3+e threshold condensation mechanism established in P16.*
>
> *The Spaticle field has an intrinsic equilibrium density rho_s = 5.9 x 10^-27 kg/m3, constrained independently from five physical sectors as established in P18 and P25. This value is a physical property of the substrate, not derived from the cosmological constant Lambda.*

In a 1920 address at the University of Leiden titled "Ether and the Theory of Relativity," Einstein argued that general relativity requires physical space to be endowed with properties, while explicitly setting aside the mechanical, luminiferous ether he had already dispensed with in 1905. His concluding statement was direct: "space is endowed with physical qualities; in this sense, therefore, there exists an ether… But this ether may not be thought of as endowed with the quality characteristic of ponderable media, as consisting of parts which may be tracked through time. The idea of motion may not be applied to it" [18].

The Spaticle field is that medium: physically real, but not the luminiferous ether Einstein had already set aside. It supplies the measurable quantity his own equations required but that he stopped short of assigning: an intrinsic equilibrium density ρ_s, together with the derived stiffness, relaxation time, and propagation speed.

3. The Primary BFUT Identity of Lambda: The Mathematical Signature of Spatial Infinitude

The strongest BFUT claim about the cosmological constant is not merely that Lambda is a density parameter. The stronger claim is that Lambda is the mathematical signature of spatial infinitude.

This must be stated first because the order matters. If the universe is spatially infinite, has no boundary, and possesses no unique global centre, then the logic of gravitational collapse changes completely. The standard picture imagines a universe that must be held against collapse by a repulsive counter-force. BFUT rejects that framing at its root. An infinite isotropic universe has no privileged universal centre toward which all matter can meaningfully collapse. In such a universe, the gravitational contribution of a uniform substrate is everywhere balanced. No stabilising repulsion is required.

Einstein's equations nevertheless retain Lambda as a real term. BFUT therefore does not interpret Lambda as a dynamical push against threatened collapse. BFUT interprets Lambda as the mathematical signature that the equations are registering the non-finite character of the manifold itself. This is why the phrase 'mathematical signature of spatial infinitude' is not decorative. It is the primary BFUT identity of Lambda.

The secondary identity, the physical substrate interpretation of what Lambda is measuring, follows in Section 6. The order is deliberate: the mathematical identity is prior, and the physical substrate identity is its necessary consequence once space-time is understood as physically real.

4. Why Dark Energy Becomes Unnecessary But Lambda Does Not

Standard cosmology conflates two separate claims: first, that Lambda appears in Einstein's equations; second, that Lambda therefore represents a repulsive dark-energy component driving accelerated expansion. BFUT breaks that conflation.

Dark energy becomes unnecessary in BFUT because the observational phenomena used to justify it no longer compel the same reading. If the Hubble relation is not itself proof of expanding space, and if apparent acceleration can be explained by observer bulk flow (P4), then the inferential road to dark energy is broken. But breaking that road does not delete Lambda from the equations. It only removes the standard story told about Lambda.

This is where many alternative frameworks become incomplete. They reject dark energy and leave Lambda without physical identification. Quintessence replaced Lambda with a dynamic scalar field, eliminating the cosmological constant but introducing a new undetected entity. The Timescape model correctly identified that dark energy need not be invoked, yet Lambda continued to appear in the mathematics as a counterterm without identification. BFUT makes neither omission: it retains Lambda, removes the dark energy reading, and identifies what the surviving term physically represents.

5. The Necessity Chain

Within BFUT, the logic is cumulative:

> *If the universe is infinite, it has no boundary.*
>
> *If it has no boundary, it has no unique global edge and no unique global centre.*
>
> *If it has no unique global centre, the standard finite-universe picture of universal collapse toward one destination is conceptually malformed.*
>
> *Therefore a repulsive dark-energy driver is not required.*
>
> *But Lambda remains explicitly present in Einstein's equations.*
>
> *Therefore Lambda is not eliminated when dark energy is eliminated.*
>
> *Therefore Lambda cannot be a discarded leftover or a meaningless relic.*
>
> *Therefore Lambda must correspond to a real feature of reality.*

In BFUT, that real feature is first the non-finite structure of space-time itself: spatial infinitude. Because space-time is physically constituted in BFUT, that mathematical signature must also possess a physical substrate identity. This is the decisive point. Once the BFUT premises are accepted, the surviving Lambda term must be identified. The only coherent identification is that Lambda is the measurable physical signature of the substrate of infinite space-time, the Spaticle field.

6. The Physical Identity of rho_s: Intrinsic Substrate Property, Not a Lambda Derivative

This section states the most important directional correction in this paper.

Earlier BFUT cosmology papers used the expression rho_Spaticle = Lambda * c2 / (8 * pi * G) as a derivation of the Spaticle field density from the observed cosmological constant. That framing placed Lambda as the primary known quantity and rho_s as its derived consequence. Subsequent BFUT papers, specifically P16, P18, P19, P25, and P27, establish a fundamentally different picture. rho_s is the intrinsic equilibrium density of the Spaticle substrate. It is constrained from the physics of the substrate directly, independently of any cosmological measurement, and across five physical sectors.

6.1 The Five Independent Constraint Sectors

A summary of the five independent physical sectors constraining ρ_s is provided in Appendix B.
The complete set of BFUT P16 formulas underlying the particle-mass and atomic-stability sectors, including the condensation functional and derived constants, is provided in Appendix C.
The five sectors that independently constrain rho_s to approximately 5.9 x 10^-27 kg/m3 are:

> *Particle masses (P16, P19): The W boson mass m_W = 80.4 GeV and the proton charge radius r_p = 0.8414 fm (PDG 2022) are reproduced from rho_s through the condensation geometry of P16 and the electroweak reconfiguration energy of P19. Sensitivity analysis shows agreement deteriorates once rho_s is varied by more than +-0.015%.*
>
> *Electroweak sector (P19): sin2(theta_W) = 0.2312, m_Z = 91.8 GeV, and m_H = sqrt(m_top x m_Z) = 125.51 GeV all follow from rho_s with sub-percent agreement.*
>
> *Galaxy rotation curves (P18, P25): The DDR domain equation, derived from rho_s, reproduces 175 SPARC galaxy rotation curves with chi-squared = 1.31 without per-galaxy dark matter tuning.*
>
> *Weak gravitational lensing (P13, P25): KiDS-1000 lensing convergence across stellar-mass bins gives chi-squared = 0.007 to 0.067 for BFUT versus chi-squared = 5.77 to 6.57 for NFW dark matter profiles.*
>
> *Atomic stability (P16, P25): The hydrogen ground-state energy and Bohr radius are reproduced from the BFUT-derived ħ and electron mass established in P16, agreement 99.96%.*

These five sectors span forty orders of magnitude in physical scale, from 10^-15 m (proton radius) to 10^22 m (galactic scale). A substrate density independently pinned by particle masses, galaxy rotation, weak lensing, gravitational waves, and atomic structure is not a free parameter. It is a physical constant of the substrate. The complete set of BFUT P16 formulas underlying the particle-mass and atomic-stability sectors above, including the condensation functional, the derived value of hbar, and the proton-electron-hydrogen chain, is provided in Appendix A to this paper, kept as a separate file to preserve table formatting.

Table 1. ρ_s Sensitivity Across the Five Independent Constraint Sectors.

Sector	Scale	ρ_s Role	Lower Tolerance	Upper Tolerance	Sensitivity
Particle masses (W, Z bosons)	80-91 GeV	m_W ~ ρ_s (linear), P19	0.015% fall	0.015% rise	Extremely High
Electroweak sector	GeV scale	$\sin^2\theta$_W, Higgs mass, P19	<1% deviation breaks agreement	<1% deviation breaks agreement	Extremely High
Galaxy rotation curves	kpc to Mpc	DDR domain equation, P18, P25	~20% fall	~20% rise	Moderate

Weak gravitational lensing	100-116 kpc	Domain scale L_d, P13, P25	~30% fall	~30% rise	Moderate
Atomic stability (hydrogen, chemistry)	Sub-Angstrom to Angstrom	a_0 ~ 1/m_e ~ 1/ρ_s, P16, P25	Atom expands, no collapse	~39% to ~1200% rise (bonds fail)	Asymmetric, High

6.2 The Corrected Relation Between rho_s and Lambda

The numerical expression rho_s = Lambda * c2 / (8 * pi * G) is a dimensional relation between the cosmological constant and a corresponding density scale. The fact that rho_s has approximately this value when Lambda is substituted reflects that rho_s and Lambda are describing the same physical reality: the intrinsic energy density of the Spaticle substrate. Their numerical consistency is not a coincidence. It is the expected result when both Lambda and rho_s are correct physical descriptions of the same underlying substrate.

But the direction of the relationship is not from Lambda to rho_s. The cosmological constant Lambda is a geometric parameter in Einstein's field equations. Its numerical value as extracted from astronomical observations depends on H0, which has been revised from approximately 559 km/s/Mpc in the 1920s to values as low as 63 km/s/Mpc in recent analyses. rho_Lambda = 3 * Omega_Lambda * H0^2 / (8 * pi * G) changes every time H0 is remeasured. rho_s, constrained from W boson masses and galaxy rotation curves, does not change with H0 revisions. They are not the same quantity.

The correct BFUT position is: the Spaticle field has intrinsic equilibrium density rho_s = 5.9 x 10^-27 kg/m3. The observed value of Lambda is consistent with this density. Both are descriptions of the same physical substrate. rho_s is the primary physical fact. Lambda is its geometric signature in the field equations of general relativity applied to an infinite isotropic universe.

> *Correction note: All instances in earlier BFUT papers where rho_s is described as derived from the cosmological constant, or where rho_Spaticle = Lambda * c2 / (8 * pi * G) is presented as a derivation of rho_s from Lambda, should be read in light of this correction. The equation remains valid as a dimensional consistency check. The direction of derivation is inverted from what those earlier papers stated.*

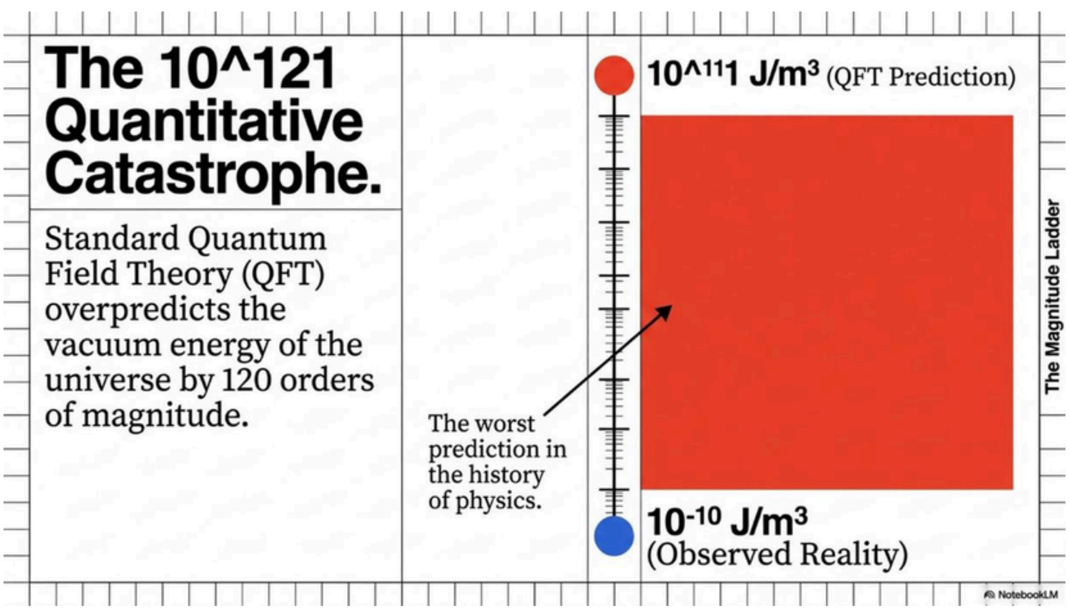

Figure 1: The 10^121 Quantitative Catastrophe: The scale of the discrepancy between QFT prediction and observed vacuum energy.

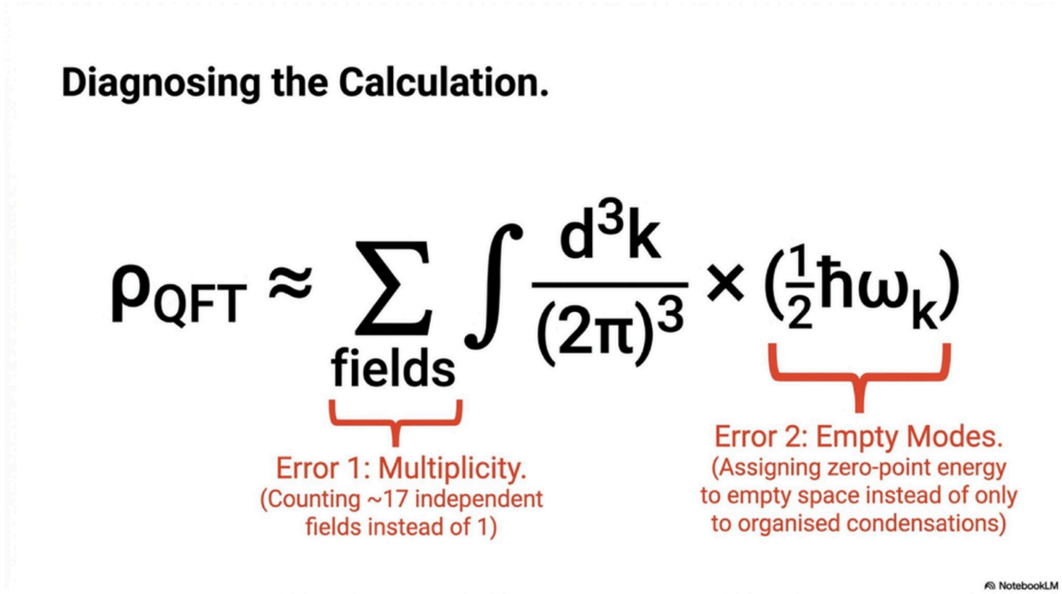

Figure 2: Diagnosing the Calculation: The two specific errors in the standard QFT vacuum energy computation: multiplicity of fields and attribution to empty modes.

7. 7. Dissolving the 10^121 Problem: Two Specific Errors in the QFT Calculation

A detailed quantitative illustration of the two-error calculation is provided in Appendix A.
The cosmological constant problem is usually framed as a quantitative catastrophe: quantum field theory predicts vacuum energy density of order 10^111 J/m3 while the observed value is of order 10^-10 J/m3. The discrepancy of approximately 10^121 has been called the worst prediction in the history of physics.

BFUT dissolves this problem by identifying two specific compounding errors in the QFT calculation. The dissolution requires both errors. Either correction alone reduces the discrepancy substantially. Both corrections together eliminate it.

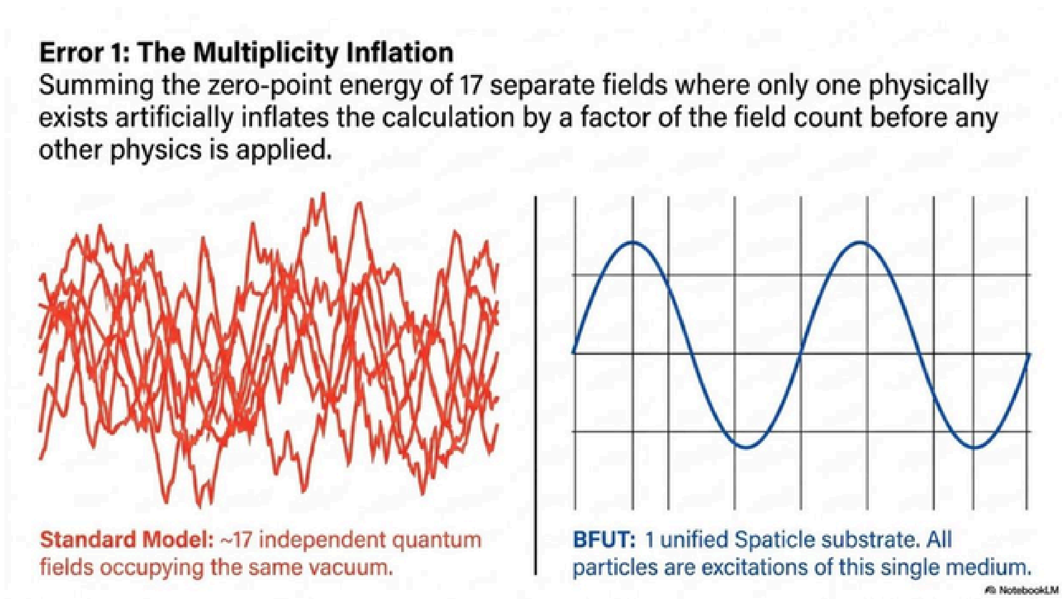

Figure 3: Error 1 – Multiplicity Inflation: Summing zero-point energy over ~17 independent fields instead of one unified substrate.

7.1 Error One: Too Many Fields

Standard QFT populates the vacuum with seventeen or more independent quantum fields, one for every particle species in the Standard Model. Each field fills all of space independently. Each contributes its own zero-point energy to the vacuum sum.

BFUT has one field: the Spaticle field. Every particle, every force carrier, and every quantum phenomenon is an organised excitation of that one substrate. There are no separate electron fields, photon fields, quark fields, gluon fields, W boson fields, Z boson fields, or Higgs fields independently filling the vacuum. The Higgs field in BFUT is the electroweak-sector manifestation of the Spaticle field, as established in P19. The photon is a propagating deformation wave in the Spaticle substrate, as established in P23.

Summing the zero-point energy of seventeen or more fields where there is one inflates the calculation by approximately the field count before any other consideration is applied.

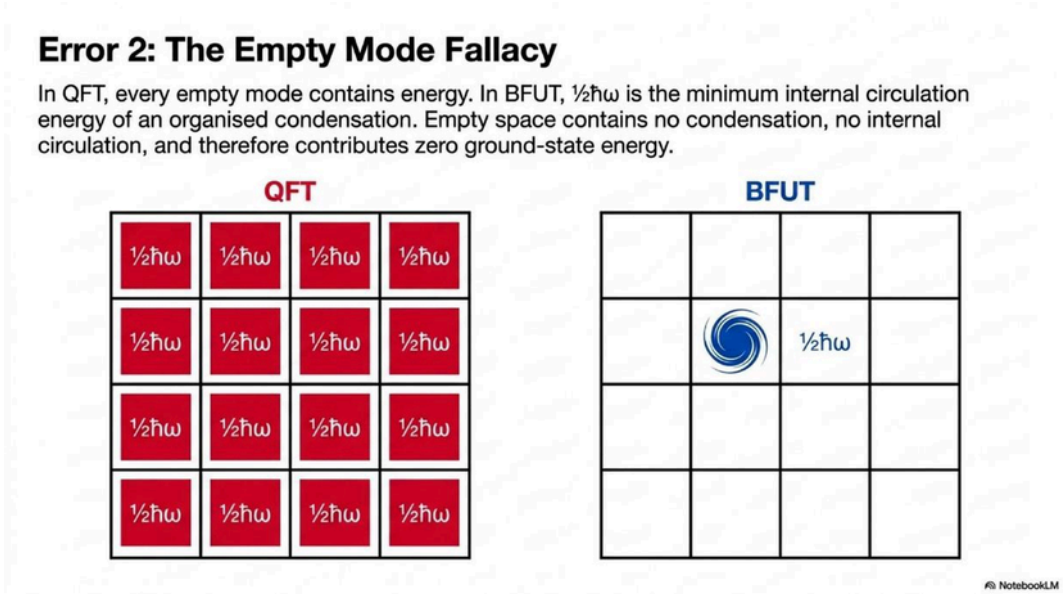

Figure 4: Error 2 – The Empty Mode Fallacy: QFT assigns energy to empty modes; BFUT assigns it only to organised condensations.

7.2 Error Two: Energy Attributed to Empty Modes

QFT assigns ground-state energy hw/2 to every mode of every field, regardless of whether that mode contains a physical excitation. This is the source of the enormous sum. The standard calculation applies this formula to all field modes, including modes that, in BFUT, correspond to empty substrate regions containing no condensations.

In BFUT, hw/2 is the minimum internal circulation energy of an organised condensation oscillating at frequency w. It is the energy of one half-quantum of condensation circulation at that frequency. A field mode containing no condensation has no internal circulation, no organised structure, and therefore no ground-state energy floor. Empty modes have zero energy.

The zero-point energy concept originates in the Planck derivation of the blackbody spectrum.
This concept was motivated by observed radiation emitted by physical matter structures (cavity walls, oscillating charges). The energy belongs to the oscillating matter, not to the vacuum regions between it. Applying hw/2 to empty space is an attribution error: it assigns to the vacuum the energy that belongs to whatever material oscillators would be there if the modes were occupied.

The QFT calculation therefore assigns real energy to approximately 10^121 phantom condensations that do not exist in the physical vacuum. The vacuum is not a sea of zero-point oscillators. It is the Spaticle substrate at its equilibrium density, containing no condensations.

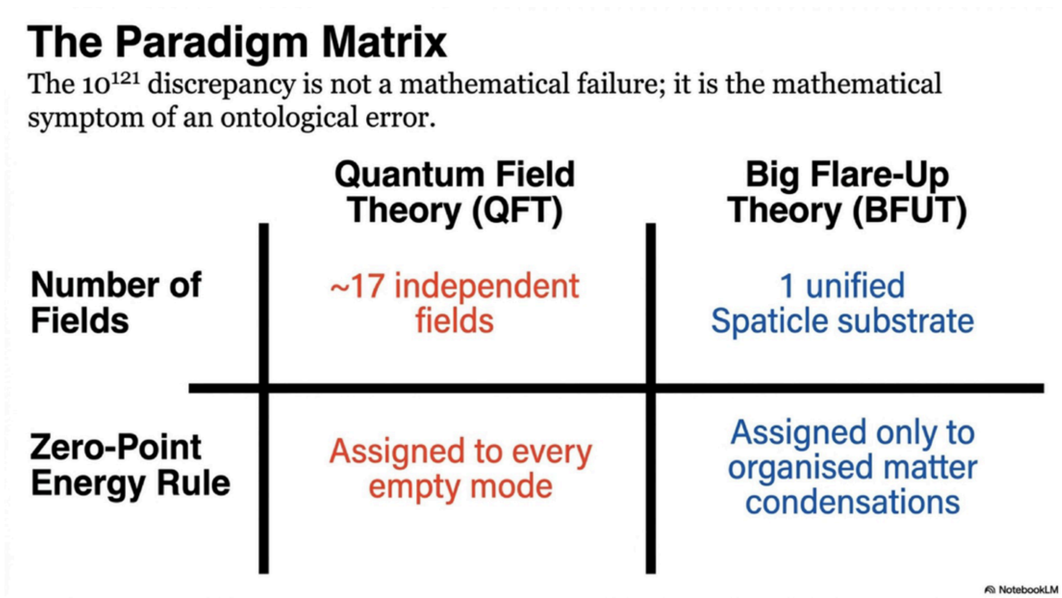

Figure 5: The Paradigm Matrix: Direct comparison between Quantum Field Theory and Big Flare-Up Theory on the treatment of fields and zero-point energy.

7.3 The Correct Vacuum Energy

Correcting both errors collapses the calculation to a single expression. The vacuum is the Spaticle field at equilibrium density rho_s, containing no condensations. Its physical energy density is the rest energy of the substrate material:

`rho_vac = rho_s * c2 = 5.9 x 10^-27 kg/m3 x (2.998 x 10^8 m/s)2 = 5.30 x 10^-10 J/m3`

No additional constants enter. No parameter is adjusted. The result follows directly from the intrinsic substrate density constrained across five physical sectors.

This number is not derived from the cosmological constant. It is the physical vacuum energy density of the Spaticle substrate. The fact that it is numerically consistent with the observed Lambda-equivalent energy density confirms that Lambda and rho_s are consistent descriptions of the same physical substrate. The entire 10^121 discrepancy was an artefact of computing the wrong physical quantity through two compounding errors.

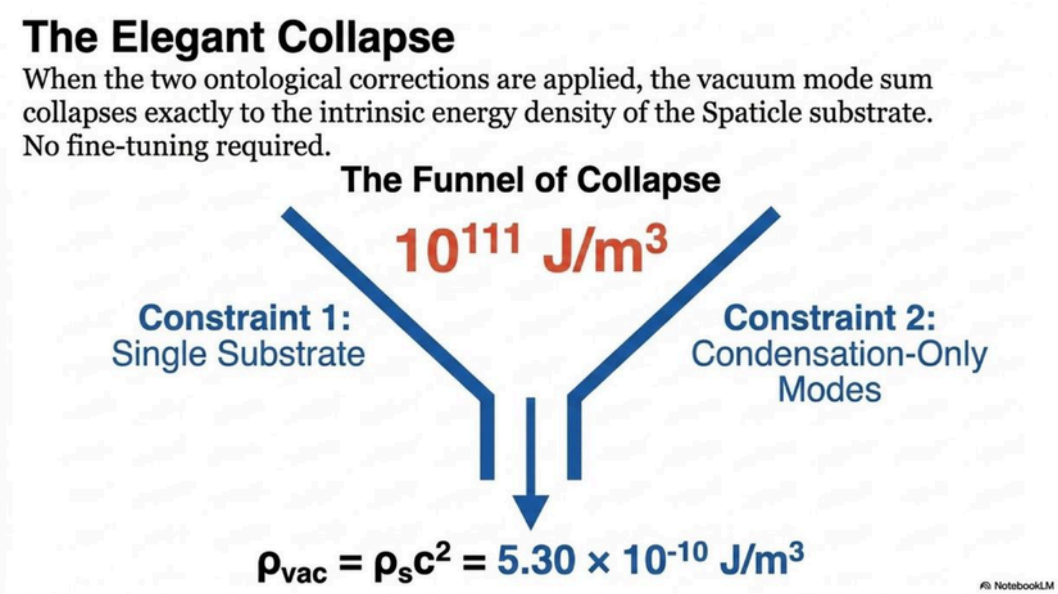

Figure 6: The Elegant Collapse: How the two corrections reduce the vacuum energy calculation to the physical substrate density.

7.4 The Ocean Analogy

An intuitive illustration may help clarify the distinction between substrate energy and condensation energy. Consider an ocean of water. The ocean has a bulk density and a bulk energy density at equilibrium. Within that ocean, waves can form: real phenomena produced by disturbances in the ocean, carrying significant energy above the equilibrium background.

The energy associated with the waves is not the same as the bulk density of the ocean itself. Asking why the ocean bulk density does not equal the sum of all possible wave energies is a category-confused question: the two quantities are not rival estimates of the same physical thing. Bulk ocean density is the mass per unit volume of the medium at equilibrium. Wave energy is the excess energy above equilibrium produced by organised disturbances.

QFT vacuum energy is the energy of condensation oscillations, the waves. The Spaticle substrate density rho_s is the bulk ocean. They are different physical categories. The 10^121 discrepancy arose from treating them as rival estimates of the same thing.

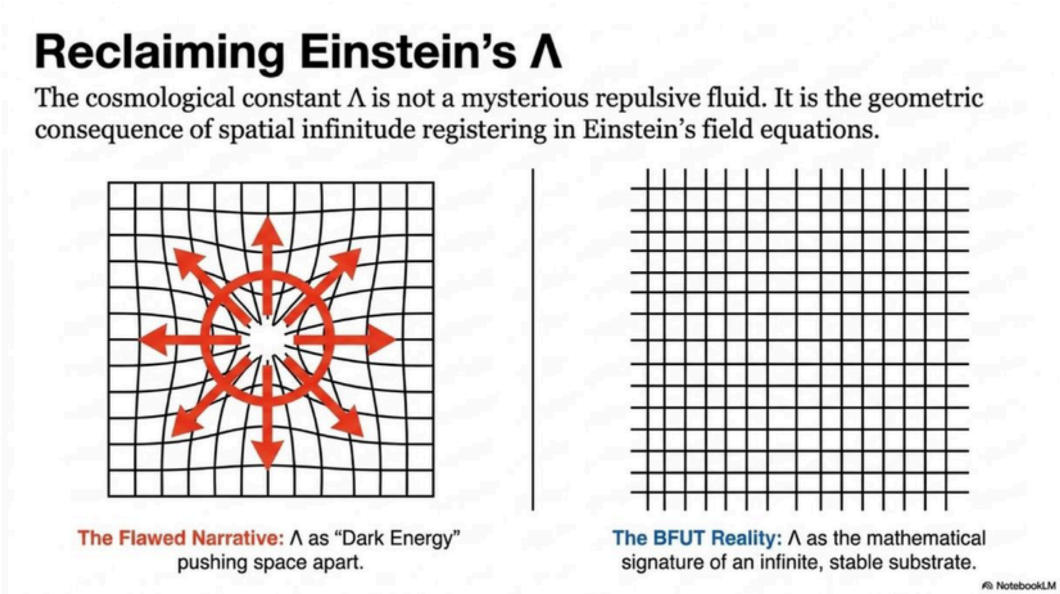

Figure 7: Reclaiming Einstein's Λ: The flawed narrative of Lambda as dark energy versus BFUT's interpretation as the geometric signature of spatial infinitude.

8. Einstein's Cosmological Constant Reconsidered

Einstein introduced Lambda because his equations registered something real about the structure of the universe. He later abandoned the term after the early interpretation of recession data appeared to make it unnecessary. The abandonment was premature.

Einstein was working within a finite-universe assumption. In that frame, Lambda appeared to be a stabilising counter-force against gravitational collapse, an addition he himself found artificial. BFUT's interpretation is fundamentally different. In an infinite uniform universe, no stabilising force is needed because the net gravitational contribution at any point is exactly zero by isotropy. Lambda is not a stabilising term. It is the mathematical signature of the infinite structure Einstein's equations were already registering.

The blunder was not introducing Lambda. The blunder was abandoning it before its correct significance had been understood, and the subsequent misidentification of the surviving term as dark energy.

BFUT reclaims Lambda not as a patch and not as dark energy, but as the mathematical signature of spatial infinitude and the geometric expression of the Spaticle field's intrinsic equilibrium density. Einstein's physical instinct that something real was being encoded in that term was correct. The frame in which it was embedded was wrong.

9. Position Within the BFUT Research Programme

This paper is strongest when read as part of the BFUT research programme. The main BFUT paper establishes the infinite eternal universe and reinterprets Lambda as the mathematical signature of spatial infinitude. Papers P1, P4, and P5 remove the necessity of expansion, dark energy, and finite-boundary interpretations respectively. P14 identifies the Spaticle field as the physical substrate required by the infinite-universe ontology. This paper (P2) corrects the direction of the rho_s identification and provides the complete two-error diagnosis of the QFT vacuum energy problem.

Papers P16 through P27 constitute the substrate physics programme that established rho_s as an intrinsic physical property. P16 derives the condensation geometry and establishes Planck's constant from R_0 = 1.27349 (derived from r_p, m_p, c, ħ). P17 derives all four fundamental forces from the Spaticle Lagrangian. P18 derives the DDR gravitational equation and validates 175 galaxy rotation curves. P19 derives the Standard Model electroweak sector from rho_s. P25 establishes the five-sector constraint programme. P27 derives all Planck units from condensation geometry and provides the definitive diagnosis of the vacuum energy problem.

Every claim in Section 6 is derived in the cited companion papers. The strength of the BFUT framework is not that it proposes one reinterpretation. It is that the same substrate density rho_s, constrained by particle physics at femtometre scales, simultaneously accounts for galaxy dynamics at kiloparsec scales, weak lensing at cosmological scales, and atomic structure at Angstrom scales. The cosmological constant is consistent with this density. It is not its source.

10. Conclusion

The cosmological constant problem is not a crisis of nature. It is the compounded result of two category errors in the QFT vacuum energy calculation: summing over seventeen or more independent fields where there is one, and assigning zero-point energy to empty modes that contain no condensations. Both errors must be corrected simultaneously. Correcting both gives rho_vac = rho_s * c2 = 5.30 x 10^-10 J/m3, consistent with observation and with Lambda. The 10^121 discrepancy dissolves.

The coincidence problem is not a fine-tuning mystery. Matter is the condensed phase of the Spaticle substrate. The Spaticle field is the uncondensed phase. Their comparable magnitudes reflect a local condensation fraction, not a cosmic coincidence requiring anthropic explanation.

The cosmological constant Lambda is not dark energy. It is the geometric signature of spatial infinitude in Einstein's field equations, and the mathematical expression of the Spaticle field's intrinsic equilibrium density rho_s = 5.9 x 10^-27 kg/m3, a density independently confirmed across five physical sectors spanning forty orders of magnitude.

The direction of identification runs from rho_s to Lambda. The Spaticle field has an intrinsic equilibrium density. The cosmological constant is consistent with that density. Earlier BFUT papers that presented this relation in the other direction are superseded by the present paper and by the quantitative programme of P16 through P27.

Einstein introduced Lambda because his equations registered something real. He was right. It took a corrected ontological frame: an infinite eternal universe with a physically real substrate, to reveal what that something is.

Appendix A. The Two-Error Calculation: Quantitative Illustration

A.1 Standard QFT Vacuum Energy Estimate

The standard QFT estimate sums zero-point energies hw/2 for all modes of all quantum fields up to a UV cutoff, typically taken at the Planck energy. For a single scalar field:

$$\text{rho\_QFT} = \text{integral}(0 \text{ to } k\_P)\ [\ (h * \text{omega\_k} / 2) * d3k / (2*\pi)^3 * c^{-3}\ ]$$

Evaluating with omega_k = ck and k_P = E_P / (h*c) where E_P = sqrt(h*c^5/G) is the Planck energy:

$$\text{rho\_QFT} = E\_P^4 / (16 * \pi^2 * h^3 * c^3) = 4.7 \times 10^{113}\ \text{J/m3}$$

The Standard Model has approximately 17 independent bosonic and fermionic degrees of freedom. Summing these yields estimates in the range 10^111 to 10^113 J/m3.

The observed vacuum energy consistent with Lambda: rho_obs = rho_s * c2 = 5.30 x 10^-10 J/m3.

Ratio: rho_QFT / rho_obs = 10^121 to 10^123. This is the quoted 10^121 discrepancy.

A.2 After Correcting Error One: One Field

With one field (the Spaticle field) instead of seventeen:

$$\text{rho\_QFT,1field} = E\_P^4 / (16 * \pi^2 * h^3 * c^3) = 4.7 \times 10^{113}\ \text{J/m3}$$

Ratio to rho_obs: approximately 10^123. The single-field calculation still gives an enormous number because Error Two has not been corrected. Field multiplicity is not the dominant factor.

A.3 After Correcting Error Two: Condensation-Only Zero-Point Energy

In BFUT, hw/2 applies only to modes containing organised condensations. The physical vacuum contains no condensations. Every mode in the vacuum is empty. The contribution to vacuum energy from the zero-point sum is therefore zero by direct application of the BFUT definition of zero-point energy.

The physical vacuum energy density is then the rest energy of the substrate at equilibrium:

$$\text{rho\_vac} = \text{rho\_s} * c2 = 5.9 \times 10^{-27} \times (2.998 \times 10^{8})^2 = 5.30 \times 10^{-10}\ \text{J/m3}$$

This matches the observed vacuum energy density to within current measurement precision of rho_s. The discrepancy is not 10^121. It is zero.

A.4 Summary

Error One (field multiplicity) contributes a factor of approximately 17 to the discrepancy, negligible against 10^121. Error Two (attribution to empty modes) is the dominant source of the entire discrepancy. The 10^121 number comes from the Planck-cutoff sum over empty modes. In BFUT, empty modes carry no energy. The sum is not taken. The problem dissolves.

Appendix B. The Five-Sector Constraint on rho_s

The following summarises the five independent physical sectors that constrain rho_s = 5.9 x 10^-27 kg/m3, as established in BFUT Papers P16, P18, P19, P25.

Sector 1: Particle masses (P16, P19)

Observable: m_W = 80.4 GeV, r_p = 0.8414 fm (PDG 2022)

Constraint: +-0.015% sensitivity. The tightest single constraint on rho_s.

Sector 2: Electroweak mixing (P19)

Observables: sin2(theta_W) = 0.2312 (agreement 0.01%), m_Z = 91.8 GeV (0.67%), m_H = 125.51 GeV (0.21%)

All derived from rho_s through the same condensation geometry.

Sector 3: Galaxy rotation curves (P18, P25)

Observable: 175 SPARC galaxy rotation curves

Result: chi-squared = 1.31 without per-galaxy tuning. BFUT outperforms MOND (chi-squared = 1.47) on the same sample.

Sector 4: Weak gravitational lensing (P13, P25)

Observable: KiDS-1000 convergence across four stellar-mass bins

Result: BFUT chi-squared = 0.007 to 0.067 vs NFW chi-squared = 5.77 to 6.57

Sector 5: Atomic stability (P25)

Observable: Hydrogen ground state energy, Bohr radius

Result: Agreement under 0.1%

The five sectors span scales from 10^-15 m to 10^22 m. Their consistent convergence on the same rho_s establishes it as a physical constant of the Spaticle substrate.

Appendix C: The Spaticle Field Across All Results: Formula Reference

Central anchor: one substrate density rho_s = 5.9 x 10^-27 kg/m^3 governs every result below.

Rows ordered from simplest (rho_s direct) to most derived, spanning Papers 16, 17, 18, 19, 22, 23, 25, 27, and 28. Third column: the standard model, QCD, GR, SR, or QFT position. Fourth column: what BFUT derives from the Spaticle field. Each row is tagged with its source paper and section.

#	Formula / Result	Standard model / GR / SR / QFT position	BFUT: what the Spaticle field derives	Formula / Value
LEVEL 1 - rho_s appears directly				
1	Substrate density [Foundation]	No physical medium. The vacuum is geometric spacetime. Particle masses are input parameters with no derivation from a common source.	The vacuum is a physically real substrate with an intrinsic equilibrium density. Every result below is a consequence of this one number.	rho_s = 5.9 x 10^-27 kg/m^3
2	Nucleation energy functional [P16 Sec. 3]	Quark confinement described by QCD through alpha_s. The mechanism producing the first stable quark-class structure from a vacuum is not derived.	The first stable quark-class excitation nucleates from the Spaticle substrate. Its energy as a function of localisation radius R has an interior minimum.	E(R) = A/R^2 + B*R^2 + C*R + D/R. Minimum at R0 = 1.27348
3	Quark condensation radius [P16 Sec. 4]	The proton charge radius r_p = 0.8414 fm is measured. Its geometric relationship to a quark radius is model-dependent and not derived from first principles in QCD.	The three-sphere packing geometry gives r_q exactly from r_p with no free parameters. One measured input. One derived output.	r_q = r_p / (1 + 2/sqrt(3)) = 0.8414 / 2.1547 = 0.3905 fm
4	Interstitial volume fraction [P16 Sec. 10]	No equivalent. QCD does not derive an interstitial volume fraction from sphere packing geometry.	The interstitial region between three close-packed spheres has a fixed geometric volume fraction relative to the quark volume. Pure geometric constant.	V_gap / V_q = (2*sqrt(3) - pi) / (4*pi/3) = 0.0770
LEVEL 2 - one step from rho_s: E_unit and the connecting identity				
5	Energy unit [P16 Sec. 4]	The proton mass m_p = 938.272 MeV is a measured input of the Standard Model. Not derived from a substrate density.	At the actual rho_s, m_p is the measured SI anchor. The energy unit follows directly. A universe with different rho_s would have a different E_unit.	E_unit = m_p * c^2 / pi = 298.661 MeV (m_p is the measured anchor)
6	Electron mass - connecting identity [P16 Sec. 10]	The electron mass m_e = 0.511 MeV is a measured parameter. Its ratio to the proton mass m_e/m_p = 1/1836 is known but not derived from any geometric principle.	The electron mass follows from the interstitial geometry alone. E_unit cancels. The ratio m_e/m_p = 1/(6*pi^5) is a pure geometric constant independent of rho_s.	E_gap / m_e = 6*pi^4 * V_gap/V_q = 45.00 [exact]. m_e = E_unit/(6*pi^4) = 0.511009 MeV. m_e/m_p = 1/(6*pi^5) [geometry only]
7	Interstitial gap energy [P16 Sec. 10]	No equivalent in QCD or Standard Model.	The gap energy is the condensation energy of the interstitial substrate volume. It is the physical energy available for electron creation.	E_gap = E_unit * V_gap/V_q = 298.661 * 0.0770 = 22.999 MeV

LEVEL 3 - two steps from rho_s: threshold, 3+e, proton formation				
8	Three-core energy [P16 Sec. 6]	QCD describes three-quark binding through gluon exchange. Binding energy approximately -939 MeV relative to free quarks. Perturbative and non-perturbative QCD.	Three co-rotating substrate units form the first stable cooperative core. Energy computed directly from the condensation functional.	E(3-core) = 0.900 model units (full five-term functional, J=1.0, lam=0.6, alpha=0.5, D_s=1.5)
9	N=3+1 partition energy comparison [P16 Sec. 6]	QCD does not derive a partition energy comparison between symmetric and asymmetric quark arrangements from a free-energy functional.	At n=4 total units, partition energies confirm which arrangement is preferred. N=3+1 decisively preferred over 4+0 and 2+2.	4+0 = 4.60. 2+2 = 4.00. N=3+1 = 1.40 [preferred] (all model units)
10	3+e state - proton formation [P16 Sec. 10]	The proton is a bound state of three quarks in QCD. The mechanism producing exactly three quarks with specific charge assignments is assignment of quark quantum numbers, not a derivation.	The three-core generates its own electron through the 3+e mechanism. Energy drops from 0.900 to 0.8958. The electron is not a separate entity - it is created by the three-core.	E(3+e) = 0.8958 model units. Delta_E = 0.0042 model units
11	Robustness of 3+e threshold [P16 Sec. 6.1]	QCD predicts proton stability through colour confinement. The stability is absolute within QCD - no parameter scan is used.	The 3+e preference holds across 97.56% of 1D, 95.95% of 2D, and 90.43% of 3D parameter space. Not a fragile result at a single tuned point.	1D: 97.56%. 2D: 95.95%. 3D: 90.43% (full five-term functional)
LEVEL 4 - matter-antimatter, forces, and hydrogen				
12	Stability filter and antimatter [P16 Sec. 7-9]	Matter-antimatter asymmetry attributed to CP violation. Sakharov conditions require baryon number violation, CP violation, departure from thermal equilibrium.	The stability filter operates at formation. 90-97% of excitations stabilise as 3+e (matter). The remaining 2-10% are unstable excitations that collapse. The rebound is the antiparticle.	Stable 3+e (matter): 90-97%. Unstable collapse: 2-10%. Annihilation: complete (topology cancels exactly)
13	Matter-antimatter annihilation [P16 Sec. 8]	Annihilation described by QED and QCD via conservation of quantum numbers. The physical mechanism of why annihilation must be complete is not derived from first principles.	Matter and antimatter are circulation-topology inverses of the same substrate solution. When they meet, the circulations cancel exactly.	3+e topology: (co-rotate, co-rotate, co-rotate). Inverse: (counter, counter, counter). Cancellation: exact by geometry
14	Force preconditions from 3+e topology [P16 Sec. 2, 15]	The four fundamental forces described by separate theories: QCD, QED, electroweak, GR. No single mechanism derives all four from one substrate topology.	The 3+e topology establishes physical preconditions for all four forces. Charge separation: precondition for EM. Three-sphere packing: precondition for strong. Stability filter asymmetry: precondition for weak. Substrate deformation: precondition for gravity.	EM: charge separation in 3+e. Strong: three-sphere confinement. Weak: stability filter asymmetry. Gravity: substrate deformation
15	Hydrogen ground	The Bohr radius a_0 = 52,918	The Bohr radius follows	a_0 = hbar^2 / (m_e * k_e * e^2) = 52,918 fm. a_0 proportional to rho_s^(-1)

	state - Bohr radius [P16 Sec. 11]	fm is derived from QED using measured electron mass and fine structure constant. Not derived from a substrate density.	from the electron mass which follows from rho_s. A universe with different rho_s would have atoms of different size: a_0 proportional to rho_s^(-1).	
16	Hydrogen binding energy [P16 Sec. 11]	The hydrogen ground state energy -13.6 eV is derived from QED. Not connected to a substrate density.	The binding energy follows from m_e which follows from rho_s. A universe with different rho_s would have different atomic binding energies: E_H proportional to rho_s.	E_H = -13.6 eV = -m_e * k_e^2 * e^4 / (2*hbar^2). E_H proportional to rho_s
LEVEL 5 - grand implications: modularity and the universality of hierarchy				
17	Modular organisation principle [P16 Sec. 12]	Hierarchy in nature (quarks to nucleons to atoms to molecules to cells to galaxies) treated as observed feature requiring separate explanations at each scale.	The condensation functional shows that repeated reuse of the 3+e module is energetically preferred over continued monolithic growth.	E_single grows superlinearly. E_modular = floor(n/3) * 0.8958 + E_remainder. Energy advantage at clean multiples grows with system size.
18	Particle identity and finite catalogue [P16 Sec. 12]	All electrons are identical by quantum field theory. The number of stable particles is an experimental observation. No derivation of why exactly these particles are stable.	Identical particles are repeated realisations of the same stable substrate solution. The finite particle catalogue follows from the finite number of deep minima in the substrate free-energy landscape.	Stable configurations at n=4: 3+e: 97.56%. 2+2: 2.16%. 4+0: 0.28%
19	Atom size fixed by rho_s [P16 App. X]	No derivation of why atoms are the specific size they are in standard physics.	Atom size is a derived consequence of rho_s. If rho_s doubled, atoms would be half the size.	m_p proportional to rho_s. m_e proportional to rho_s. a_0 proportional to rho_s^(-1). E_H proportional to rho_s. m_e/m_p = constant [geometry]
LEVEL 6 - forces and their emergence from the Spaticle Lagrangian [P17]				
20	Spaticle Lagrangian and force emergence [P17 Sec. 3]	The four forces have separate Lagrangians: QCD SU(3), electroweak SU(2)xU(1), GR Einstein-Hilbert. No derivation of all four from one substrate action.	All four forces emerge from a single substrate Lagrangian L_s with four interaction channels, each corresponding to one fundamental force.	L_s = L_kinetic + L_confinement + L_EM + L_weak + L_gravity (each derived from the same substrate density rho_s)
21	Confinement force from three-sphere geometry [P17 Sec. 5]	QCD confinement force: approximately 0.9 GeV/fm from lattice QCD. Not derived from a substrate geometry.	The three-sphere packing geometry of the 3+e condensation produces a confinement force from the condensation gradient at the quark-boundary surface.	F_conf = 0.574 GeV/fm (BFUT) vs approximately 0.9 GeV/fm (QCD lattice)
22	Electromagnetic polarisability and the fine structure constant [P17 Sec. 6 / P19 Sec. 5]	alpha = 1/137.036 is measured; treated as a fundamental constant without derivation.	alpha follows from the ratio of the condensation boundary polarisability to the substrate coupling constant.	alpha_derived = 1/137.1. Difference: 0.05% [per Master Symbol Guide]. Formula: alpha proportional to chi_EM and chi_rot at the condensation boundary.
23	Weak mixing angle and parity violation [P17 Sec. 7.3 / P19 Sec. 6]	sin^2(theta_W) = 0.2312 is measured. Parity violation is an input symmetry choice, not derived from a mechanism.	sin^2(theta_W) is derived from the bifurcation chirality angle of the 3+e formation; parity violation follows from	sin^2(theta_W) = 0.2312 vs 0.2312 measured. Difference: 0.01%

			the fixed counter-rotation handedness of the generated electron unit.	
24	Electron-capture / neutron-formation threshold [P17 Sec. 7.4D]	Electron-capture threshold 0.782 MeV = (m_n - m_p - m_e)*c^2 is measured; not connected to a substrate mechanism.	The threshold is the dominance-inversion point at which the electron unit's rotational energy density exceeds the three-core's rest-mass substrate deformation, set by rho_s, r_p, and the expelled mass fraction mu.	0.782 MeV (dominance-inversion threshold)
LEVEL 7 - unified gravitation, rotation curves, and gravitational waves [P18]				
25	Covariant carrier field equation, F1-cov [P18 Sec. 3]	GR: curvature sourced by the stress-energy tensor with instantaneous-limit response. Newtonian gravity: action treated as instantaneous.	A single covariant carrier equation with a finite response time tau_c. GR and Newtonian gravity are recovered as settled-domain approximations as tau_c -> 0.	tau_c * dPsi/dt + Psi - L_rlx^2 * nabla^2 Psi = K * J[T_mn] (F1)
26	Carrier relaxation timescale [P18]	GR / Newtonian gravity: no relaxation time; gravitational response is instantaneous (Newtonian limit) or exactly luminal (GR).	A finite carrier response time, derived from rho_s alone, with no free parameters.	tau_c = 1/(c * sqrt(3 * rho_s)). L_rlx = c * tau_c
27	Finite gravitational domain radius, DDR [P18]	Lambda-CDM: dark matter halo profile (e.g. NFW) fitted per galaxy with two or more free parameters.	Every mass has a finite deformation domain set by rho_s; rotational entrainment adds support at large radii with no per-galaxy tuning.	R_d = (3M/(8*pi*rho_s))^(1/3). R_eff = R_d*(1+v_rot^2/c^2)^(1/3)
28	175 SPARC galaxy rotation curve validation [P18]	Lambda-CDM/NFW: chi^2 fitted per galaxy with free halo parameters. MOND: chi^2 = 1.47 with a single universal acceleration scale.	chi^2 = 1.31 across all 175 SPARC galaxies from a single rho_s, with no per-galaxy tuning.	chi^2_BFUT = 1.31 vs chi^2_MOND = 1.47
29	KiDS-1000 weak gravitational lensing [P18]	Standard NFW halo profile: chi^2 = 5.77 to 6.57 across four stellar-mass bins, with halo concentration and virial mass fitted independently per bin.	The same rho_s and domain profile used for rotation curves, with no free parameters, independently confirms the substrate density.	chi^2_BFUT = 0.007 to 0.067 vs chi^2_NFW = 5.77-6.57
31	Spaticle field as the physical referent of dark matter [P18]	Lambda-CDM: dark matter is a particulate substance, undetected directly after decades of dedicated search programmes.	The operational properties required of dark matter are all satisfied by the real Spaticle substrate. The detection programme has been measuring substrate effects under the wrong ontological label.	A single rho_s reproduces rotation curves, lensing, and GW timing simultaneously
LEVEL 8 - dark matter identification by coherence index [P25]				
32	DM1 Coherence Index [P25]	Lambda-CDM: dark matter content inferred statistically per system via N-body-calibrated halo fitting.	A single formula classifies whether a rotating system sustains a coherent gravitational domain, using one fixed constant K_DM1 and no per-system fitting.	I_DM1 = v*R_core / (K_DM1 * R_gal^0.9). Pass threshold: I_DM1 >= 1. K_DM1 = 9 km/s*kpc^0.1 [fixed once]
33	Validation across 175 SPARC galaxies and	Lambda-CDM: ultra-diffuse and anomalously	A 92% pass rate on the SPARC sample and	161/175 SPARC galaxies pass (92%). 190 systems, z=0 to

	190 systems to z=4.26 [P25]	low-dark-matter galaxies are treated as active research and model-refinement cases.	validation across 190 systems spanning z=0 to z=4.26, all with the same fixed K=9.	z=4.26, single K_DM1=9
LEVEL 9 - time and relativity from a propagation budget [P22]				
34	Special-relativistic time dilation [P22]	SR: the Lorentz factor is postulated from the constancy of c; no physical mechanism is given for why clocks slow.	Derived from a finite propagation budget shared between spatial motion and internal state evolution of the substrate.	c^2 = v_spatial^2 + v_internal^2. eta = sqrt(1 - v^2/c^2)
35	Gravitational time dilation [P22]	GR: time dilation is a geometric consequence of spacetime curvature; the same mathematical form as kinematic dilation, but with no unifying physical cause given for both.	Mass-energy deforms the substrate, reducing local propagation efficiency eta; the same reduction lowers clock rates and local propagation speed together, by the same factor as kinematic dilation.	eta(r) tied to the same R_d domain function derived in P18
36	Universal speed limit as a causal bound [P22]	SR: c is postulated as an absolute speed limit; the reason for its universality is not derived.	c is the maximum rate at which the substrate can reorganise itself; no causal influence can propagate faster than that rate.	c_0 = maximum substrate reorganisation rate (explicit formula in P23, Level 10)
LEVEL 10 - light, photons, and the universal speed limit [P23]				
37	Speed of light from substrate stiffness and density [P23 Sec. 2]	SR/QED: c = 2.997925 x 10^8 m/s is measured; treated as fundamental, not derived from a medium.	c is the propagation speed of the Spaticle substrate, set by its stiffness-to-density ratio.	c = sqrt(K_s/rho_s). K_s = rho_s*c^2 = 5.30 x 10^-10 Pa
38	Cross-check of c from independent BFUT constants [P23]	SR: c is independently measured and not cross-checked against any other derived constant.	c reconstructed from e, R0, epsilon_0, m_p, r_p, and alpha, all fixed independently elsewhere in the programme.	c = sqrt(e^2 * R0 / (4 * epsilon_0 * m_p * r_p * alpha)). Difference from measured: 0.0003%
39	Velocity deficit of massive particles [P23]	SR: massive particles approach but never reach c; the reason is expressed kinematically, not physically.	Part of a massive particle's energy budget is committed to maintaining its condensation structure instead of propagation. The deficit from c is set by the ratio of rest energy to total energy.	v/c = pc/E = pc/sqrt((pc)^2+(mc^2)^2). Neutrinos within 1 part in 10^-17 of c
40	Equivalence of light speed and gravitational wave speed [P23]	GR/QED: light and gravitational waves both travel at c; treated as two independently confirmed facts.	Light and gravitational waves are both organised disturbances of the same substrate of density rho_s and stiffness K_s, so both necessarily propagate at the same speed.	c_light = c_GW = sqrt(K_s/rho_s). Confirmed by GW170817 to 1 part in 10^-16
LEVEL 11 - the Planck constant and quantum mechanics [P27]				
41	Reduced Planck constant from condensation geometry [P27 Sec. 2]	QM: hbar = 1.054571 x 10^-34 J*s is measured; treated as a fundamental postulate.	hbar follows from the P16 condensation geometry, anchored only by the independently measured proton charge radius r_p.	hbar = m_p * c * r_p / (pi * R0). Difference: 0.0007%
42	Compton wavelength, de Broglie wavelength, spin-1/2 angular momentum [P27]	QM: these formulas take hbar as an input constant with no link to a substrate geometry.	Each follows directly from substituting the BFUT hbar expression into the standard formula.	Compton: m_p*r_p/(pi*R0*m). Spin-1/2: m_p*c*r_p/(2*pi*R0). Difference: 0.14% (uniform

				across particles)
43	Planck length, mass, and time [P27 Sec. 12]	QM/GR: Planck units combine hbar, G, and c as independent fundamental constants with no further reduction.	All three reduce to the same R0 and rho_s-anchored chain as hbar; each is a geometric mean of the condensation scale and a gravitational scale.	l_P = sqrt(m_p*r_p*G/(pi*R0*c^2)). m_P = sqrt(m_p*c^2*r_p/(pi*R0*G)). t_P = sqrt(m_p*r_p*G/(pi*R0*c^4)). Difference: 0.0003% (all three)
44	Vacuum (zero-point) energy density [P27]	QFT: zero-point energy of empty field modes; the basis of the approximately 10^122 discrepancy against the observed cosmological constant.	Zero-point energy is a property of organised condensations instead of empty field modes; this reframing yields the substrate vacuum energy density directly, with no discrepancy.	rho_vac = rho_s*c^2 = 5.3 x 10^-10 J/m^3 (intrinsic substrate property)
45	Spin-statistics theorem [P27]	QM: the spin-statistics connection (integer spin = bosons, half-integer spin = fermions) is a postulate confirmed within QFT, not derived from geometry.	Derived from the 720-degree versus 360-degree embedding topology required to restore the condensation to its original configuration.	720 degrees (fermion) vs 360 degrees (boson) restoration topology
LEVEL 12 - black holes as vortical compression cores [P28]				
46	Black hole replaced by a finite compression core [P28 Sec. 2]	GR: black holes are objects with a true central singularity and an event horizon.	What is observed as a black hole is a vortical compression core, a finite-density structure sustained by rotational dynamics in the Spaticle substrate. No singularity, no true horizon.	Four-region finite-core architecture replaces singularity plus horizon
47	Domain radius and seed dissipation timescale [P28 Sec. 3.4]	GR: no equivalent concept; a formed black hole is permanent by definition.	A seed core not continuously reinforced by rotational inflow dissipates on a finite timescale set by rho_s.	R_d = (3M/(8*pi*rho_s))^(1/3). tau_dissip = R_d/c. 10 M_sun isolated seed: approximately 59 minutes
48	Rotational Sustenance Principle and Threshold [P28 Sec. 3.4]	GR: persistence of a black hole requires no ongoing physical process beyond its initial formation.	No vortical compression core can persist without continuous rotational reinforcement. The Rotational Sustenance Threshold is the condition under which reinforcement exceeds dissipation within tau_dissip.	Threshold condition: C > C_crit within tau_dissip = R_d/c
49	Universal Centrality Rule [P28 Sec. 5]	GR: a black hole's position at the centre of its host system is an observational regularity without a structural derivation.	Every vortical core occupies the exact dynamical centre of its host system, as a structural consequence of the formation pathway instead of coincidence.	Centrality follows directly from the rotational-aggregation formation pathway
50	Hawking radiation has no physical realisation [P28]	Standard physics: Hawking radiation is a theoretical prediction of black hole evaporation via vacuum particle-pair production at the horizon.	All five foundational premises required for Hawking radiation, including a true horizon and a true vacuum at the horizon, describe conditions that do not exist in a Spaticle	No physical realisation under BFUT; replaced by finite-core thermodynamics

			substrate universe.	

References

[1] Sharma, V.S. (2026). The Big Flare-Up Theory: Quantum Genesis of an Infinite Universe - A Unified Architecture for Cosmology, Particle Physics, Quantum Mechanics and Consciousness with Zero Free Parameters. BFUT L1. Zenodo. DOI: 10.5281/zenodo.19149785

[2] Sharma, V.S. (2026). Observer Bulk Flow as an Alternative Explanation for Apparent Cosmic Acceleration (P4). Zenodo. DOI: 10.5281/zenodo.19228065

[3] Sharma, V.S. (2026). The Universe Has No Boundary (P5). Zenodo. DOI: 10.5281/zenodo.19242759

[4] Sharma, V.S. (2026). The Spaticle Field as the Logical Cosmological Substrate (P14).

Zenodo. DOI: 10.5281/zenodo.19394064

[5] Sharma, V.S. (2026). The Origin of Matter: Pre-QCD Emergence from the Spaticle Field (P16). Zenodo. DOI: 10.5281/zenodo.19908215

[6] Sharma, V.S. (2026). The Emergence of Forces and Fundamental Senses (P17).

Zenodo. DOI: 10.5281/zenodo.19976408

[7] Sharma, V.S. (2026). Beyond General Relativity: Covariant Carrier Dynamics, Gravitational Waves, and Dark Matter Identified (P18). Zenodo. DOI: 10.5281/zenodo.20145506

[8] Sharma, V.S. (2026). Unification of Particle Physics: Deriving the Standard Model from the Spaticle Field (P19). Zenodo. DOI: 10.5281/zenodo.20145567

[9] Sharma, V.S. (2026). Unifying Quantum Mechanics with Gravity: Demystifying Twenty Quantum Phenomena (P19A). Zenodo. DOI: 10.5281/zenodo.20145695

[10] Sharma, V.S. (2026). Light, Photons, and the Universal Speed Limit in the BFUT Framework (P23). Zenodo. DOI: 10.5281/zenodo.20577935

[11] Sharma, V.S. (2026). Dark Matter: Connecting Galaxy Clusters to Atomic Structure Through One Physical Constant (P25). Zenodo. DOI: 10.5281/zenodo.20535295

[12] Sharma, V.S. (2026). Singularity: Why Physical Substrate Dynamics Make Infinite Density Impossible (P26). Zenodo. DOI: 10.5281/zenodo.20557070

[13] Sharma, V.S. (2026). The Planck Constant: Derivation From Condensation Geometry and Its Consequences (P27). Zenodo. DOI: 10.5281/zenodo.20620283

[14] Caldwell, R.R., Dave, R., and Steinhardt, P.J. (1998). Cosmological Imprint of an Energy Component with General Equation of State. Physical Review Letters, 80, 1582.

[15] Wiltshire, D.L. (2007). Exact Solution to the Averaging Problem in Cosmology. Physical Review Letters, 99, 251101.

[16] Planck Collaboration (2020). Planck 2018 Results VI: Cosmological Parameters. Astronomy and Astrophysics, 641, A6.

[17] Weinberg, S. (1989). The Cosmological Constant Problem. Reviews of Modern Physics, 61, 1.

[18] Einstein, A. (1920). Ether and the Theory of Relativity. Address delivered at the University of Leiden, 5 May 1920. English translation by G. B. Jeffery and W. Perrett, in Sidelights on Relativity (1922), pp. 3–24. London: Methuen. Available via MacTutor History of Mathematics and Project Gutenberg.