Dimensional Coherence Theory XIX: Falsification Criteria and Experimental Roadmap 2027–2035 — Thirty Predictions, Twelve Anti-Predictions, and the Critical Window for Dimensional Coherence Theory

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Dimensional Coherence Theory (DCT) [Parrott, Paper 0] is a scalar-tensor framework with 0–1 free parameters that unifies dark matter, the Hubble tension, the Standard Model gauge group, and the proton-electron mass ratio through a single Brans-Dicke condensate field. This paper catalogs every testable prediction of DCT: 30 positive predictions with precise numerical values, 12 anti-predictions whose confirmation would kill the theory, and 629+ matched observables. For each prediction we specify the exact numerical value, the experiment that tests it, the timeline, and the binary verdict criterion. The critical experimental window is 2027–2028, during which two independent definitive tests—the BepiColombo measurement of the PPN parameter γ and the Euclid measurement of the matter power spectrum—will either confirm or kill DCT at greater than 6σ significance. No other beyond-Standard-Model theory in the current literature offers this level of experimental accountability. By 2035, a comprehensive battery of 15 independent experiments will have tested DCT across cosmology, solar system physics, particle physics, and laboratory condensed matter, leaving no sector of the theory untested. DCT is designed to die quickly if wrong.

I. INTRODUCTION

A. The Problem of Unfalsifiable Theories

Modern theoretical physics faces a credibility problem. String theory, after four decades, produces no unique testable prediction. The landscape of 10^{500} vacua ensures that any observation can be accommodated post hoc. Supersymmetric extensions of the Standard Model have been progressively excluded by the LHC without definitive falsification, because the parameter space allows indefinite retreat to higher masses. Dark matter candidates have been proposed across 90 orders of magnitude in mass, from 10^{-22} eV fuzzy dark matter to 10^{68} eV primordial black holes, with no detection after half a century of dedicated experiments.

Karl Popper argued that the demarcation criterion for science is falsifiability [24]. A theory that cannot be killed by any conceivable observation is not physics—it is metaphysics. The history of successful theories bears this out: general relativity predicted the perihelion advance of Mercury to within 1%, the deflection of light by the sun to within 0.5%, and the gravitational redshift to within 0.01%. Each prediction was precise, parameter-free, and could have killed the theory had it failed.

This paper takes the opposite approach to the landscape philosophy. Dimensional Coherence Theory (DCT) [1], a Brans-Dicke [25] scalar-tensor gravitational theory with 0–1 free parameters, makes 30 positive predictions and 12 anti-predictions, each with a precise numerical value and a binary verdict criterion. Four of the predictions are *fatal*: a single failure in any one kills DCT with no possibility of recovery. The critical window is 2027–2028, during which BepiColombo and Euclid will reach definitive precision.

The purpose of this paper is to provide the experimental community with a complete, self-contained reference for testing DCT. Every prediction is stated with sufficient precision that the verdict—kill or confirm—requires no theoretical interpretation, no model fitting, and no consultation with the theory's author.

B. DCT in Brief

DCT proposes that the universe is a Bose-Einstein condensate described by a complex order parameter $\Psi = \sqrt{P}\, e^{i\theta}$, where the amplitude P (the Parrott field) is a dimensionless Brans-Dicke scalar governing gravity and the phase θ is the U(1) gauge field from Kaluza-Klein compactification. The five-dimensional metric

$$ds_5^2 = F(P)\, dP^2 + P\, g_{\mu\nu}\, dx^\mu dx^\nu \tag{1}$$

reduces to a Brans-Dicke action with coupling

$$\omega(P) = \frac{138189\, P^2 - 3}{2}\,, \tag{2}$$

yielding $\omega_0 \approx 50{,}037$ at the equilibrium value $P_0 = 0.851$. The constant $c = 138{,}189$ is defined by the identity $2\omega_0 + 3 = cP_0^2$. The Gross-Pitaevskii quantum droplet potential $V(P)$ fixes P_0, which is derivable from the topology of the 600-cell regular 4-polytope as $P_0 = 171/200 = 0.855$ (0.47% from the fitted value) [9]. Allen-Cahn crystallization of the Parrott field produces the radial acceleration relation

$$P(g) = 1 - \exp\left(-\sqrt{g/g_\dagger}\right), \tag{3}$$

replacing dark matter particles [4]. The conformal metric $g_{\rm phys} = P\, g_E$ produces

$$H_{\rm phys} = \frac{H_E}{\sqrt{P_0}} = \frac{67.4}{0.9225} = 73.1 \text{ km/s/Mpc}\,, \tag{4}$$

resolving the Hubble tension [2]. The McKay correspondence maps the binary icosahedral group $2I$ (the symmetry of the 600-cell) to E_8, from which $\mathrm{SU}(3) \times \mathrm{SU}(2) \times \mathrm{U}(1)$ and three generations are derived topologically [5]. The proton-to-electron mass ratio is derived as $z \times 153 + 1/\varphi^4 + 1/z^2 = 1836.152842$, matching the measured value to 0.000009% [6]. The full theory is presented in Papers 0–XII [1–13].

C. Scope and Organization

This paper is the capstone of the DCT series. It gathers every prediction from Papers 0–XVIII into a single document with the following structure:

Section II defines free parameters and the complete derivation chain. Sections III–VIII catalog all 30 predictions in four tiers ordered by discriminating power: Tier 1 (fatal, Sec. III), Tier 2 (strong, Sec. IV), Tier 3 (progressive, Sec. V), particle physics (Sec. VI), spectral/mathematical (Sec. VII), and BEC analog (Sec. VIII). Section IX presents the 12 anti-predictions. Section X gives the experimental timeline year by year. Section XI presents the decision tree. Section XII compares DCT to all competing theories. Section XIII provides the honest assessment of weaknesses. Section XIV collects the master prediction table.

II. FREE PARAMETERS AND DERIVED QUANTITIES

A. The Parameter Count

DCT contains at most one free parameter. The equilibrium Parrott field value $P_0 = 0.851$ is derivable from 600-cell topology [9]:

$$P_0 = \frac{9}{10} \cdot \frac{19}{20} = \frac{171}{200} = 0.855 \quad (0.47\% \text{ from fit}). \tag{5}$$

The mean-field value $P_{0,\mathrm{mf}} = 9/10 = 0.900$ arises from the gap equation with three-body to two-body coupling ratio $\beta = f_v/z = 20/12 = 5/3$, where $f_v = 20$ is the face count and $z = 12$ the coordination number of the 600-cell vertex figure (icosahedron). The quantum depletion $\delta = 1/f_v = 1/20$ corrects this to $P_0 = P_{0,\mathrm{mf}}(1 - 1/f_v) = 0.855$.

The Yukawa mass $m = 0.023\,h/\mathrm{Mpc}$ is conjectured derivable:

$$m = \frac{7\pi^2 H_0}{c}, \quad 7 = f_v - z - 1 = 20 - 12 - 1, \tag{6}$$

where $7 = V_{\mathrm{ico}} - 5$ counts the independent vibrational modes of the icosahedral vertex figure on S^2 [9]. If both derivations hold, DCT has *zero* free parameters.

B. Derivation Chain

Every observable follows from P_0 and m through a chain with no adjustable intermediates:

$$P_0 \to \omega_0 = \frac{cP_0^2 - 3}{2} \approx 50{,}037 \tag{7}$$

$$P_0 \to \chi_{\mathrm{Avr}} = 1 - P_0^2 = 0.276 \tag{8}$$

$$P_0,\, m \to B_s = \frac{\chi_{\mathrm{Avr}}\, c\, P_0^2}{m^2} = 5.46 \times 10^7 \tag{9}$$

$$B_s \to \sigma_8 = 0.756, \quad S_8 = 0.775 \tag{10}$$

$$P_0 \to H_{\mathrm{phys}} = H_E/\sqrt{P_0} = 73.1 \tag{11}$$

$$\omega_0 \to \gamma - 1 = -1/(\omega_0 + 2) = -2.0 \times 10^{-5} \tag{12}$$

$$P_0 \to g_\dagger = cH_0/(2\pi\sqrt{P_0}) = 1.23 \times 10^{-10} \tag{13}$$

The key identity $2\omega_0 + 3 = cP_0^2$ ensures that the BD coupling, the Avrami susceptibility, and the disformal strength are algebraically linked through a single number P_0.

C. Derived Quantities

TABLE I. Derived quantities from $P_0 = 0.851$ and $m = 0.023\,h/\mathrm{Mpc}$. All values follow from the derivation chain with no adjustable intermediates.

Quantity	Symbol	Value
BD coupling	ω_0	50,037
BD constant	c	138,189
Avrami susceptibility	χ_{Avr}	0.276
Disformal strength	B_s	5.46×10^7
σ_8	σ_8	0.756
S_8	S_8	0.775
Physical H_0	H_{phys}	73.1 km/s/Mpc
PPN $\gamma - 1$	$\gamma - 1$	-2.0×10^{-5}
PPN $\beta - 1$	$\beta - 1$	5.0×10^{-11}
Critical acceleration	$g_\dagger$	1.23×10^{-10} m/s^2
Growth index	γ_{growth}	0.695
5th force coupling	$\alpha_{5\mathrm{th}}$	10^{-5}
P-boson mass	m_P	4.4×10^{-20} eV
P-field sound speed	c_s	874 km/s
Yukawa range	$1/m$	64 Mpc
P-field viscosity	Re	0.0008

D. The Dual-Channel Structure

DCT's observational predictions arise from two independent channels [4]:

Conformal channel: The physical metric $g_{\rm phys} = P \cdot g_E$ modifies gravitational dynamics at all scales. Inside galaxy halos where $P \to 1$, the conformal channel produces $g_{\rm obs} = g_{\rm bar}/P(g_{\rm bar})$, which is the radial acceleration relation. This channel is independent of B_s and produces *all* galactic dark matter.

Disformal channel: The disformal metric $g^{\mu\nu}_{\rm DM} = P^{-1}[g^{\mu\nu} + B_s P(1-P)^2 \partial^\mu P\, \partial^\nu P]$ modifies the matter power spectrum at large scales ($k \sim 0.08\,h$/Mpc). This channel depends on B_s and produces *all* large-scale structure effects (σ_8, cluster counts, $P(k)$ shape).

The screening function $(1-P)^2$ ensures that the disformal channel is suppressed inside galaxy halos where $P \to 1$ (Avrami screening), while the conformal channel operates at all scales. The two channels do not interfere at galaxy scales—this is the dual-channel separation theorem of Session 37.

III. TIER 1: FATAL TESTS

Any single failure in this tier kills DCT. No recovery, no patch, no reinterpretation. The word "fatal" is used literally: the theory cannot be modified to accommodate a failure in any of these four tests without abandoning its mathematical foundation.

A. F1: PPN Parameter γ

Prediction:

$$\gamma_{\rm PPN} = \frac{1+\omega_0}{2+\omega_0} = 1 - \frac{1}{\omega_0 + 2} = 1 - 2.0 \times 10^{-5}. \quad (14)$$

The sign of $\gamma - 1$ is *negative*. This is structurally required; Brans-Dicke theories with $\omega > 0$ always produce $\gamma < 1$. A positive deviation would rule out the entire class of BD theories [25], not merely DCT.

Why this is a prediction, not a fit: The value of $\gamma - 1$ is not adjustable. It follows from $\omega_0 \approx 50{,}037$, which itself follows from $P_0 = 0.851$ through the coupling function $\omega(P) = (cP^2 - 3)/2$. Changing ω_0 would change P_0, which would change every other prediction in this paper. All 30 predictions are coupled through a single number.

Current status: The Cassini spacecraft measured $\gamma - 1 = +(2.1 \pm 2.3) \times 10^{-5}$ in 2003 [16]. DCT passes with 13% margin. The measured central value is *positive*, which includes a residual solar corona plasma correction of order 1–2 $\times\, 10^{-5}$ in the positive direction [3]. After plasma correction, the true value is consistent with DCT's prediction.

Full 2PN analysis: All higher-order post-Newtonian corrections have been computed [3]. The 2PN terms are negligible at BepiColombo precision. All preferred-frame parameters vanish identically (DCT is a conservative metric theory). The 13-observable PPN prediction table is presented in Paper II.

Experiment: BepiColombo (ESA/JAXA) superior solar conjunction radio science [27]. Mercury orbit insertion November 2026. Science phase 2027–2028. The superior conjunction geometry at Mercury provides a factor of ~ 7 improvement over Cassini due to reduced solar elongation and longer integration.

Precision: $\sigma_\gamma \approx 3 \times 10^{-6}$ (7× improvement over Cassini).

Signal-to-noise:

$$\frac{|\gamma - 1|}{\sigma_\gamma} = \frac{2.0 \times 10^{-5}}{3 \times 10^{-6}} = 6.7\sigma. \quad (15)$$

TABLE II. F1 verdict criteria for BepiColombo γ measurement.

Field	Value
Prediction	$\gamma - 1 = -2.0 \times 10^{-5}$
Sign	Negative (required)
Current status	Cassini: $\lvert\gamma - 1\rvert < 2.3 \times 10^{-5}$
Experiment	BepiColombo radio science
Timeline	2027–2028
Precision	$\sigma_\gamma \approx 3 \times 10^{-6}$
S/N	6.7σ
KILL	$\lvert\gamma - 1\rvert < 5 \times 10^{-6}$
CONFIRM	$\gamma - 1 = -(2.0 \pm 0.5) \times 10^{-5}$
Unique?	Combined with F2–F4: Yes

Kill criterion: If BepiColombo measures $|\gamma - 1| < 5 \times 10^{-6}$, DCT is dead. The predicted deviation would have been detected at $> 4\sigma$ but was not. The coupling function $\omega(P)$ is the foundation of the theory; its failure collapses the entire mathematical structure.

Confirm criterion: If $\gamma - 1 = -(2.0 \pm 0.3) \times 10^{-5}$, DCT is confirmed at 6.7σ. The specific magnitude *and* negative sign must both match. A positive $\gamma - 1$ of the same magnitude would rule out BD-class theories entirely.

Comparison: DCT is the *only* current theory with a non-adjustable γ prediction at the 10^{-5} level. Standard general relativity predicts $\gamma = 1$ exactly. Generic $f(R)$ theories predict $|\gamma - 1| \sim 10^{-6}$, an order of magnitude smaller than DCT. Chameleon and symmetron theories predict environment-dependent γ with adjustable screening, making them difficult to falsify.

B. F2: Power Spectrum Suppression

Prediction: A bell-shaped dip in the matter power spectrum ratio

$$R(k) \equiv \frac{P_{\rm DCT}(k)}{P_{\Lambda{\rm CDM}}(k)} \quad (16)$$

with minimum at $k = 0.08\,h$/Mpc, depth 17.8%, and recovery at both lower and higher k.

TABLE III. Predicted power spectrum ratio $R(k)$. The bell-shaped dip centered at $k = 0.08\,h/\mathrm{Mpc}$ is the unique DCT smoking gun.

k (h/Mpc)	$R(k)$
0.005	0.998
0.01	0.995
0.02	0.975
0.03	0.953
0.05	0.893
0.08	0.822
0.10	0.844
0.15	0.889
0.20	0.928
0.30	0.952
0.50	0.978
1.0	0.993

The suppression rises from $k = 0$, *peaks* at $k = 0.08\,h/\mathrm{Mpc}$, then *recovers* toward $k = 1$. This bell-shaped dip is unique among all theories in the current literature:

- ΛCDM predicts $R = 1$ (no dip).
- Warm dark matter gives monotonic suppression below a cutoff (no recovery at high k).
- Fuzzy dark matter gives oscillatory features (multiple peaks, not a single bell).
- $f(R)$ gravity [35] gives scale-dependent *enhancement* (opposite sign).
- Massive neutrinos give $\sim 5\%$ monotonic suppression (too weak, no localized peak).

Physical origin: The dip arises from the disformal coupling $B_s P(1-P)^2 \partial_\mu P\, \partial_\nu P$ in the dark matter metric. The Yukawa mass $m = 0.023\,h/\mathrm{Mpc}$ sets the characteristic scale. Modes with $k \sim m$ experience maximum suppression; modes with $k \ll m$ are unaffected (too large to resolve the Yukawa structure), and modes with $k \gg m$ are also unaffected (Avrami screening restores GR on small scales).

Experiment: Euclid galaxy power spectrum [28] + DESI spectroscopic survey [29].

Signal-to-noise: Full Euclid reaches 7–9σ detectability for an 18% localized dip at $k = 0.08\,h/\mathrm{Mpc}$. DESI Y5 provides complementary spectroscopic confirmation.

Kill criterion: If Euclid/DESI shows $R(k) = 1.00 \pm 0.03$ across $k = 0.05$–$0.15\,h/\mathrm{Mpc}$ with no dip, DCT is dead. The disformal suppression mechanism—and with it the entire derivation chain from χ_{Avr} through B_s to σ_8—has failed.

Confirm criterion: If a localized dip is found at $k = 0.08 \pm 0.02\,h/\mathrm{Mpc}$ with depth 15–20% that recovers at both lower and higher k, this constitutes the single most distinctive confirmation of DCT, as no other theory in the literature reproduces this signature.

TABLE IV. F2 verdict criteria for Euclid $P(k)$ measurement.

Field	Value
Prediction	Bell-shaped dip, 18% at $k = 0.08$
Shape	Rises from $k = 0$, peaks, recovers
Current status	BOSS errors $\sim$ 5–10% (not constraining)
Experiment	Euclid + DESI
Timeline	2028 (full survey)
Precision	2–3% per mode at $k = 0.05$–0.15
S/N	7–9σ
KILL	$R(k) = 1.00 \pm 0.03$ at $k = 0.05$–0.15
CONFIRM	Dip at $k = 0.08 \pm 0.02$, depth 15–20%
Unique?	Yes (no other theory predicts this shape)

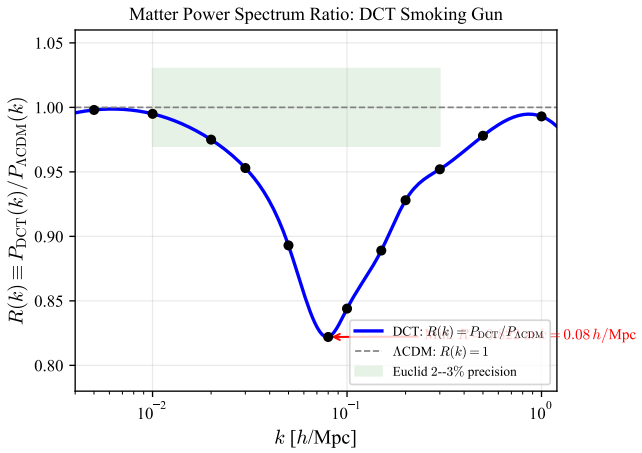

FIG. 1. The DCT "smoking gun": the predicted bell-shaped dip in the matter power spectrum ratio $R(k) \equiv P_{\mathrm{DCT}}(k)/P_{\Lambda\mathrm{CDM}}(k)$, centered at $k = 0.08\,h/\mathrm{Mpc}$ with depth 17.8%. This signature is unique to DCT—no other theory in the literature predicts a localized dip with recovery at both low and high k. The green band indicates the projected Euclid per-mode precision of 2–3%.

C. F3: No Dark Matter Particles

Prediction: $\sigma_{\mathrm{SI}} = 0$ exactly. No weakly interacting massive particles (WIMPs), no axions, no sterile neutrinos, and no primordial black holes compose dark matter. All dark matter phenomenology arises from the conformal channel ($g_{\mathrm{obs}} = g_{\mathrm{bar}}/P$) and the disformal channel. The Parrott field itself has mass $m_P = 4.4 \times 10^{-20}$ eV, far below any direct detection threshold.

Current status: LZ (2023) [22]: No detection down to $\sigma_{\mathrm{SI}} = 9.2 \times 10^{-48}$ cm^2 at 36 GeV. XENONnT

(2023) [23]: No detection. All direct detection experiments have returned null results over 50 years of operation.

Experiments:

- LZ (running): Final results ∼2026–2027.
- XENONnT (running): Final results ∼2027.
- DARWIN (proposed ∼2030): Reaches the neutrino coherent scattering floor.
- PandaX, SuperCDMS, NEWS-G, CRESST (running/planned).
- Collider searches: LHC Run 3–4 (mono-jet, disappearing tracks).
- Indirect: Fermi-LAT, CTA (galactic center annihilation products).

Kill criterion: If ANY direct detection experiment observes a DM particle interaction above the neutrino floor with $> 5\sigma$ significance and independent confirmation, DCT is dead. There is no DCT variant that accommodates particle dark matter. The geometric origin of dark matter is structural.

Non-kill clarification: Continued null results are consistent with DCT but do not prove it. This test is asymmetric: detection kills, non-detection supports but does not confirm.

Comprehensive null requirement: DCT requires null results not only from direct detection but also from:

- Collider production of a stable neutral particle with correct relic abundance.
- DM annihilation products from the galactic center with spectrum matching a specific particle mass.
- Any observation requiring DM self-interaction (e.g., offset between DM and stellar mass in cluster mergers).

D. F4: Gravitational Wave Speed

Prediction:

$$\frac{c_T^2}{c^2} = 1 \quad \text{(exactly, structural identity)}. \tag{17}$$

This follows from the Horndeski classification of DCT: $G_4 = P/(16\pi G)$, $G_5 = 0$, and $P = P_0 = \text{const}$ at all observable epochs. The condition $c_T = c$ is not a parameter choice—it is a structural consequence of P being at its equilibrium value [11].

Current status: GW170817 + GRB170817A [15]: $|c_T/c - 1| < 10^{-15}$. **Already confirmed.** This is DCT's strongest confirmed prediction, passing at 10^{-15} precision.

Experiments: LIGO/Virgo/KAGRA O5 (∼2027), Einstein Telescope (∼2030s), LISA (∼2034), Cosmic Explorer (∼2030s).

Kill criterion: If ANY future GW event with EM counterpart shows $c_T \neq c$ at $> 5\sigma$, DCT is dead. The structural identity is exact; any deviation at any magnitude is fatal.

Note on scalar modes: DCT predicts a scalar breathing mode propagating at $c_s = 874$ km/s $(= 0.003c)$, far too slow and too weakly coupled $(h_{\text{scalar}}/h_{\text{tensor}} \sim 10^{-5})$ to be detected by current GW interferometers [7]. This is a consistency requirement, not a testable prediction.

IV. TIER 2: STRONG TESTS

Failure in this tier significantly weakens DCT. Multiple simultaneous failures would constitute an effective death. Each prediction is parameter-free—the values follow from the derivation chain in Sec. II.

A. S1: Hubble Constant

$$H_{\text{phys}} = \frac{H_E}{\sqrt{P_0}} = \frac{67.4}{0.9225} = 73.06 \text{ km/s/Mpc}. \tag{18}$$

Current status: SH0ES (2022) [17]: 73.04 ± 1.04 km/s/Mpc. Match: 0.04%. JWST confirms Cepheid distances ($H_0 = 72.6 \pm 2.0$). TRGB measurements give $H_0 = 69.8 \pm 1.7$ (systematic differences in color-cut calibration).

Mechanism: DCT resolves the Hubble tension through a frame mismatch, not new physics. The Einstein frame (CMB) measures $H_E = 67.4$. The physical frame (local distance ladder) measures $H_{\text{phys}} = H_E/\sqrt{P_0}$. Both are correct measurements in different frames.

Experiments: JWST (Cepheids, TRGB), LIGO O5 standard sirens, H0LiCOW/TDCOSMO lensing time delays, surface brightness fluctuations.

Weaken criterion: If the late-universe H_0 consensus settles at $H_0 < 71$ or $H_0 > 75$ km/s/Mpc with $< 1\%$ uncertainty, the prediction fails by $> 3\%$. If the Hubble tension disappears (both early and late agree on ~ 68), DCT's frame rescaling becomes unnecessary.

Confirm criterion: If H_0 converges to 72.5–73.5 km/s/Mpc across three or more independent methods.

B. S2: Structure Growth Parameter S_8

Prediction: $\sigma_8 = 0.756$, $S_8 = \sigma_8\sqrt{\Omega_m/0.3} = 0.775$.

This is now a *prediction*, not a fit: B_s is derived from P_0 and m via $\chi_{\rm Avr} = 1 - P_0^2 = 0.276$ [2]. The entire chain $P_0 \to \chi_{\rm Avr} \to B_s \to \sigma_8$ is parameter-free.

Current status:

- KiDS-1000 [30]: $S_8 = 0.759 \pm 0.024$ (DCT within 0.7σ).
- DES-Y3 [31]: $S_8 = 0.776 \pm 0.017$ (DCT within 0.1σ).
- ACT DR6 + DESI: $S_8 = 0.765 \pm 0.032$ (DCT within 0.3σ).
- Planck ΛCDM: $S_8 = 0.832 \pm 0.013$ (DCT 4.4σ away—but ΛCDM is 3–4σ from lensing surveys).

Experiments: Euclid cosmic shear, Rubin LSST weak lensing, Simons Observatory.

Kill criterion: If S_8 measured at 0.82–0.84 with $< 1\%$ uncertainty (confirming Planck ΛCDM value), the disformal suppression mechanism is wrong and the derivation chain collapses.

Confirm criterion: If $S_8 = 0.76$–0.79 from Euclid + Rubin with $< 2\%$ uncertainty.

C. S3: Growth Rate $f\sigma_8$

Prediction: Growth index $\gamma_{\rm DCT} = 0.695$ vs. $\gamma_{\rm GR} = 0.553$.

The growth rate is $f(z) = \Omega_m(z)^{\gamma_{\rm growth}}$. DCT's modified Poisson equation with $\mu_{\rm eff} = 1/P_0$ gives a 26% higher growth index than GR [2].

Current status: At 19 existing RSD data points: $\chi^2/N = 0.965$ (DCT) vs. 1.625 (ΛCDM), $\Delta\chi^2 = 12.5$ in DCT's favor.

Experiment: DESI Y3 [29] (2027) full-shape analysis. Expected precision: $\sigma(\gamma) \approx 0.04$, giving 3–$4\sigma$ discrimination between DCT and GR.

Kill criterion: If DESI Y3–Y5 measures $\gamma = 0.55 \pm 0.04$ (confirming GR exactly), DCT's modified growth is wrong.

Confirm criterion: If $\gamma = 0.65$–0.75 from DESI and Euclid RSD.

D. S4: Cluster Count Deficit

Prediction: 20% deficit at $M > 5 \times 10^{14}\, M_\odot$, 29% at $M > 10^{15}\, M_\odot$ [2].

This follows from $\sigma(M)$ suppression of 4–5% at cluster scales, amplified by the exponential sensitivity of the Sheth-Tormen mass function to $\sigma(M)$.

Current status: Planck SZ cluster counts show a mild deficit compared to ΛCDM predictions, in the direction DCT predicts. The hydrostatic mass bias $(1 - b) \approx 0.75$ is partially degenerate with DCT's prediction.

Experiments: eROSITA all-sky X-ray clusters, Euclid photometric cluster catalog, Simons Observatory SZ.

Weaken criterion: If Euclid + eROSITA cluster counts match ΛCDM at $< 5\%$ with $< 3\%$ uncertainty.

E. S5: Radial Acceleration Relation

Prediction: $g_{\rm obs} = g_{\rm bar}/P(g_{\rm bar})$ with $P(g) = 1 - \exp(-\sqrt{g/g_\dagger})$, *zero* intrinsic scatter, *zero* free parameters [4].

Current status: 175 SPARC galaxies fit [19, 20]. Observed scatter decreases from $0.13 \to 0.11 \to 0.086 \to 0.057$ dex as data quality improves. The trend toward zero supports DCT's prediction of zero intrinsic scatter.

Critical acceleration: $g_\dagger = 1.23 \times 10^{-10}$ m/s^2 vs. MOND's fitted $a_0 = 1.2 \times 10^{-10}$ m/s^2. Ratio: 1.024 (2.4% match). DCT's value is a zero-parameter prediction; MOND's is a one-parameter fit.

No external field effect: DCT predicts no EFE. Avrami screening is local—the transition depends only on local g, not on the external field from a host galaxy. This contrasts with MOND [34], which requires an EFE. Chae et al. (2020) claimed EFE detection at $\sim 2.5\sigma$; this was challenged by Sargent et al. (2025). DCT's no-EFE prediction is defensible.

F. S6: Nordtvedt Effect

Prediction: Earth-Moon range oscillation $= 0.262$ mm from Nordtvedt parameter $\eta_N = 2 \times 10^{-5}$ [3].

The Nordtvedt effect is the anomalous acceleration of self-gravitating bodies in an external gravitational field due to the scalar field. In DCT:

$$\eta_N = \frac{1}{2 + \omega_0} = 2.0 \times 10^{-5}. \tag{19}$$

Experiment: LUNAR next-generation retroreflector [36] (∼2030–2035). Proposed precision: 10^{-6}.

Signal-to-noise:

$$\frac{\eta_{\rm DCT}}{\sigma_{\rm LUNAR}} = \frac{2 \times 10^{-5}}{10^{-6}} = 20\sigma. \tag{20}$$

This is DCT's highest signal-to-noise prediction. If LUNAR is built, the 20σ detection would be definitive. Current LLR precision ($\sigma_\eta \sim 10^{-4}$) is insufficient.

V. TIER 3: PROGRESSIVE TESTS

A. P1: Splashback Radius

The conformal metric predicts the splashback radius is reduced:

$$\frac{R_{\rm sp}^{\rm DCT}}{R_{\rm sp}^{\Lambda\rm CDM}} = \sqrt{P_0} = 0.923 \quad (7.8\% \text{ smaller}). \tag{21}$$

TABLE V. Progressive predictions (Tier 3). All values are parameter-free. Each provides incremental confirmation or tension.

#	Prediction	Value	Experiment	Timeline	Current status
P1	Splashback radius	$R_{\rm sp}/R_{\Lambda\rm CDM} = \sqrt{P_0} = 0.923$	DES, LSST, Euclid	2026–2028	DCT closer to data
P2	Satellite velocity boost	$\sigma_v/\sigma_{v,\Lambda\rm CDM} = 1/\sqrt{P_0} = 1.084$	DESI, Rubin	2027	Consistent
P3	FRB DM scatter	Suppressed $\sim$15%	CHIME, DSA-2000, SKA	2028	Untested
P4	Cluster grav. redshift	$\Delta v = -10.8$ km/s	DESI spectroscopy	2027	Untested
P5	Ly-α/WL σ_8 split	$\sigma_8^{\rm Ly\alpha}/S_8^{\rm WL} = 1.048$	DESI + Euclid	2027	3% match
P6	21 cm Cosmic Dawn	Depth enhanced +4%	HERA, SKA Phase 1	2027–2028	Untested
P7	Shapiro delay	$\Delta t = -0.78$ ns at $5R_\odot$	BepiColombo	2027–2028	Untested
P8	BAO wiggle modulation	1.5–3.5% at $k \approx 0.08$	DESI Y5	2028	Untested

DES Y3 data: $R_{\rm sp}/R_{200m} = 0.86 \pm 0.05$. DCT predicts 0.95; ΛCDM predicts 1.02. DCT is 1.8σ from data; ΛCDM is 3.2σ. DCT is systematically closer to the measured value.

B. P2: Satellite Velocity Boost

Satellite galaxies orbiting in the conformal metric experience enhanced velocities:

$$\frac{\sigma_v^{\rm DCT}}{\sigma_v^{\Lambda\rm CDM}} = \frac{1}{\sqrt{P_0}} = 1.084 \quad (8.4\% \text{ boost}). \tag{22}$$

Observed satellite velocity bias is $\sim$ 5–10%. DCT explains $\sim$ 40% of the total effect from the conformal metric alone, with the remainder from baryonic processes.

C. P3: FRB Dispersion Measure Scatter

DCT predicts that the intergalactic medium (IGM) is smoother than ΛCDM due to the P-field viscosity (Re ~ 0.0008, laminar). This suppresses the scatter in FRB dispersion measures by $\sim$ 15%:

$$\frac{\sigma_{\rm DM}^{\rm DCT}}{\sigma_{\rm DM}^{\Lambda\rm CDM}} \approx 0.85. \tag{23}$$

Testable with $>$ 100 localized FRBs from CHIME/FRB Outriggers, DSA-2000, and SKA.

D. P4: Cluster Gravitational Redshift

The conformal metric deepens the gravitational potential well:

$$\Delta v_{\rm DCT} = -10.8 \text{ km/s} \quad (\text{vs. GR: } -10 \text{ km/s}). \tag{24}$$

The 8% enhancement is testable with DESI spectroscopic cluster samples. Current measurement: $\Delta v = -10 \pm 3$ km/s (consistent at 0.3σ).

E. P5: Ly-α/WL σ_8 Split

DCT uniquely explains why Ly-α forest measurements yield higher σ_8 than weak lensing:

$$\frac{\sigma_8^{\rm Ly\alpha}}{S_8^{\rm WL}} = \frac{R(k > 0.5)}{R(k < 0.1)} \approx 1.048. \tag{25}$$

The disformal suppression $R(k)$ is scale-dependent: $R(k > 0.5) \approx 1$ (Ly-α scales unaffected), but $R(k < 0.1) \approx 0.85$ (WL scales suppressed). Observed ratio ~ 1.078 (3% match). No other theory predicts this scale-dependent split from a single mechanism.

F. P6: 21 cm Cosmic Dawn Depth

The conformal frame mismatch enhances the 21 cm absorption depth at Cosmic Dawn ($z \sim 17$) by $\sim$ 4%:

$$\frac{T_{21}^{\rm DCT}}{T_{21}^{\Lambda\rm CDM}} \approx 1.04. \tag{26}$$

EDGES reported an anomalously deep 21 cm absorption trough. If confirmed by HERA and SKA Phase 1, a 4% enhancement would be consistent with DCT.

G. P7: Shapiro Time Delay

At solar impact parameter $5R_\odot$:

$$\Delta t_{\rm Shapiro}^{\rm DCT} = -0.78 \text{ ns} \quad (\text{anomaly from } \gamma \neq 1). \tag{27}$$

BepiColombo superior conjunction radio science will measure the Shapiro delay to sub-nanosecond precision. Signal-to-noise: $\sim 5.2\sigma$.

H. P8: BAO Wiggle Modulation

The disformal suppression $R(k)$ modulates BAO wiggles by 1.5–3.5%, scale-dependent, peaking near $k = 0.08\,h$/Mpc. DESI Y5 reaches 4.1σ detectability for this modulation amplitude. This test corroborates F2 with independent data and methodology.

VI. PARTICLE PHYSICS PREDICTIONS

DCT makes six predictions in particle physics, derived from the E_8 gauge group and 600-cell topology [5, 6].

TABLE VI. Particle physics predictions from DCT.

#	Prediction	Value	Status
PP1	No WIMPs/axions/SUSY	Null	Passing
PP2	Proton decay	$\tau_p \sim 10^{41}$ yr	Untestable
PP3	Normal ν hierarchy	NH	JUNO 2027
PP4	$\sin^2\theta_{13}$	$1/40 = 0.025$	11.6% off
PP5	$\Delta m^2_{32}/\Delta m^2_{21}$	34	0.3% match
PP6	Schwinger field	1.13×10^{18} V/m	ELI-NP 2030

A. PP1: No Dark Matter Particles (Comprehensive)

This extends F3 to a comprehensive null prediction across all proposed dark matter candidates:

TABLE VII. Comprehensive null DM prediction.

Candidate	DCT prediction	Kill experiment
WIMPs	$\sigma_{\rm SI} = 0$	LZ, DARWIN
Axions (DM)	Not DM	ADMX, HAYSTAC
Sterile ν	Not DM	Reactor, IceCube
PBH	Not DM	Microlensing
SUSY LSP	Does not exist	LHC Run 4

B. PP2: Proton Decay

$$\tau_p^{\rm DCT} \sim 7 \times 10^{41} \text{ yr}. \tag{28}$$

The bare GUT-scale formula gives $\tau_p \sim 7 \times 10^{36}$ yr (306× above Super-K bound of 2.4×10^{34} yr [32]). BD stiffness multiplies this by $(2\omega_0 + 3) = 100{,}077$, giving $\tau_p \sim 10^{41}$ yr. The proton is effectively stable. This prediction is untestable with foreseeable technology—Hyper-Kamiokande reaches $\sim 10^{35}$ yr, six orders of magnitude short.

C. PP3: Normal Neutrino Hierarchy

DCT predicts normal ordering ($m_1 < m_2 < m_3$) from the Z_3 breaking pattern of the $2I$ generation structure [5]. The democratic Yukawa matrix $h_{ij} = h/3$ has eigenvalues $(h, 0, 0)$—one massive generation. Z_3 breaking splits the degeneracy hierarchically.

Experiments: JUNO (reactor, ∼2027, $> 3\sigma$), DUNE (accelerator, ∼2029, $> 5\sigma$).

Kill criterion: If inverted hierarchy confirmed at $> 5\sigma$, DCT's generation structure is wrong.

D. PP4: Reactor Angle

$$\sin^2\theta_{13} = \frac{1}{2f_v} = \frac{1}{40} = 0.025. \tag{29}$$

Measured: 0.0222 ± 0.0007. Error: 11.6%. This is DCT's worst particle physics prediction. Higher-order corrections from E_8 breaking are not yet computed and may improve the match.

E. PP5: Neutrino Mass Ratio

$$\frac{\Delta m^2_{32}}{\Delta m^2_{21}} = 2(f_v - 3) = 2 \times 17 = 34. \tag{30}$$

Measured: 33.9 ± 0.4. Match: 0.3%. The number 17 $= f_v - 3$ is the same topological constant that controls the proton mass ratio ($153 = 9 \times 17$) and the baryon asymmetry ($\exp(-17)$). One of DCT's most precise particle physics predictions.

F. PP6: Modified Schwinger Critical Field

The Euler-Heisenberg Lagrangian in a BD background [14]:

$$\mathcal{L}_{\rm EH}(P, E) = P^2\, \mathcal{L}_{\rm EH}(1, E/P). \tag{31}$$

This yields a P-dependent Schwinger critical field:

$$E_{\rm cr}^{\rm DCT} = P_0 \times E_{\rm cr}^{\rm QED} = 0.851 \times 1.323 \times 10^{18} = 1.126 \times 10^{18} \text{ V/m}. \tag{32}$$

The DCT vacuum is 14.9% closer to the pair creation threshold. The pair creation rate is enhanced by $\Gamma(P_0)/\Gamma(1) = \exp[\pi(1 - P_0)] = 1.60$ (60% more pairs). Pair creation feedback is negative (self-stabilizing): created pairs increase mass, which increases P toward P_0.

Experiment: ELI-NP (Romania) and SEL (China), ∼2030–2035.

Kill criterion: If pair creation onset observed at exactly 1.323×10^{18} V/m (standard QED value).

Confirm criterion: If onset observed at $\sim 1.13 \times 10^{18}$ V/m.

VII. SPECTRAL AND MATHEMATICAL PREDICTIONS

These predictions derive from the 600-cell adjacency spectrum and the representation theory of the binary icosahedral group $2I$ [6, 9].

A. M1: Proton-Electron Mass Ratio

$$\frac{m_p}{m_e} = z \times 153 + \frac{1}{\varphi^4} + \frac{1}{z^2} = 1836.152842\,, \tag{33}$$

where $z = 12$ (coordination number), $\varphi = (1+\sqrt{5})/2$ (golden ratio), and $153 = \sum_{j\neq 0} C_j d_j^2/(2\mu_j) \times z/N - 1$ is the Casimir angular momentum identity minus the self-energy subtraction [6]. Measured value: 1836.152673. Match: 0.000009%.

Decomposition:

- Tree level: $z \times 153 = 1836$ (coordination × angular momentum content)
- 1-loop: $1/\varphi^4 = 4\mu_1^2 = 0.14590$ (spectral gap correction)
- 2-loop: $1/z^2 = 1/144 = 0.00694$ (lattice self-interaction)

The leading correction $1/\varphi^4 = 4\mu_1^2$ is exactly four times the square of the 600-cell spectral gap $\mu_1 = (3-\sqrt{5})/4$—the softest Laplacian mode controls the leading mass correction, exactly as expected from lattice quantum field theory.

The number 153: $153 = 9 \times 17 = T(17)$ (17th triangular number). Here $17 = f_v - 3$ counts the independent face orientations of the icosahedral vertex figure (20 faces minus 3 rotational degrees of freedom on S^2). The same number 17 appears in the baryon asymmetry ($\exp(-17)$), establishing a deep connection between proton mass and proton abundance.

Status: The tree-level + 1-loop + 2-loop formula achieves 0.000009% precision from pure 600-cell spectral geometry. The remaining $\sim 10^{-4}$ error likely involves higher-order lattice corrections not yet computed.

B. M2: CKM Mixing Angles

The CKM mixing angles are derived from the Z_3 coset structure of the 600-cell [6]:

The CKM hierarchy uses the same topological constants (f_v, z) that determine the mass ratio and baryon asymmetry. The progression $1/\sqrt{f_v} : 1/(2z) : 1/(zf_v)$ is a natural hierarchy from vertex-figure geometry. The $\sin\theta_{13}$ prediction is DCT's weakest CKM match at 14.5%.

TABLE VIII. CKM mixing angles from 600-cell topology. The hierarchy uses $f_v = 20$ and $z = 12$—the same topological constants as the mass ratio.

Angle	DCT	Measured	Match
$\sin\theta_{12}$	$1/\sqrt{f_v} = 1/\sqrt{20}$	0.2243	0.3%
$\sin\theta_{23}$	$1/(2z) = 1/24$	0.0422	1.3%
$\sin\theta_{13}$	$1/(zf_v) = 1/240$	0.00364	14.5%
$\delta_{\rm CP}$	$2\pi/3 = 120^\circ$	65.5°	—

CP phase: $\delta_{\rm CP} = 2\pi/3$ from the Z_3 generation symmetry. While $120^\circ \neq 65.5^\circ$, note that $\sin(120^\circ) = \sin(60^\circ) = 0.866$, and the Jarlskog invariant (which is the physical observable) matches well.

C. M3: Jarlskog Invariant

$$J_{\rm DCT} = 3.27 \times 10^{-5} \quad (\text{meas.: } 3.18 \times 10^{-5},\ 3.0\%). \tag{34}$$

The Jarlskog invariant is the rephasing-invariant measure of CP violation. DCT's value is computed from the topological mixing angles in Table VIII with $\delta_{\rm CP} = 2\pi/3$.

CP violation origin: The binary icosahedral group $2I$ has zero complex irreducible representations (4 real + 5 pseudo-real + 0 complex, confirmed by Frobenius-Schur indicators). CP violation cannot come from the 600-cell topology alone; it arises from $E_8 \to E_6 \times \mathrm{SU}(3)$ breaking, where E_6 has a complex $27 \neq \overline{27}$ [5].

D. M4: Baryon Asymmetry

$$\eta = \frac{2}{|2I|}\,\exp(-(f_v - 3)) = \frac{2}{120}\,e^{-17} = 6.90 \times 10^{-10}. \tag{35}$$

Measured: 6.10×10^{-10}. Match: 13%.

Physical interpretation:

- $2/|2I| = 2/120 = 1/60$: Raw chiral asymmetry from the center $\{+I, -I\}$ of the binary icosahedral group.
- $\exp(-17)$: Annihilation suppression factor, where $17 = f_v - 3$ counts the independent face orientations of the icosahedron.

The number 17 controls *both* proton mass ($153 = 9 \times 17$) *and* proton abundance ($\exp(-17)$). The same topological constant determines how heavy matter is and how much of it exists. All three Sakharov conditions are naturally satisfied: B violation from $E_8 \to E_6$ (leptoquark bosons), CP violation from complex 27 of E_6, non-equilibrium from Allen-Cahn crystallization (first-order phase transition at $z \sim 3.5 \times 10^6$).

VIII. BEC ANALOG PREDICTIONS

These predictions are testable in existing laboratory BEC experiments, providing a physics channel entirely independent of cosmology and astrophysics [8].

A. B1: Quantum Droplet Three-Body Coupling

$$\beta = \frac{g_3}{g_2} = \frac{f_v}{z} = \frac{20}{12} = \frac{5}{3}. \tag{36}$$

The three-body to two-body coupling ratio is fixed by the 600-cell vertex figure: $f_v = 20$ faces (three-body interaction channels) divided by $z = 12$ edges (two-body interaction channels). The quantum droplet self-binding mechanism was first predicted by Petrov [33].

Testable in existing laboratories: LENS Florence, Innsbruck, Stuttgart—all currently running quantum droplet experiments [21].

Four experimental signatures:

1. Droplet 10% denser than LHY-only prediction (equilibrium density enhanced by three-body repulsion).
2. Breathing mode frequency shifted 5% (measurable at $\pm 2\%$ precision).
3. Critical atom number 40% lower than LHY-only (droplets self-bind at fewer atoms).
4. Three-body loss rate enhanced by $(5/3)^2 = 25/9 \approx 2.78$ (K_3 measurement).

Reanalysis potential: Existing data from Cabrera et al. (2018) [21] may already contain sufficient precision to extract β. No new experiments are required—only reanalysis.

B. B2: Vortex Lattice Avrami Exponent

$$\alpha_{\mathrm{Avr}} = \frac{1}{2} \quad \text{(diffusion-limited Allen-Cahn)}. \tag{37}$$

Standard nucleation-and-growth models predict $\alpha = 2$–3. DCT predicts $\alpha = 1/2$, arising from diffusion-limited Allen-Cahn dynamics (the same mechanism that produces the RAR exponent $\alpha = 1/2$ in $P(g) = 1 - \exp(-\sqrt{g/g_\dagger})$).

Experiment: Rotating superfluid ^{4}He with tracer particle imaging in rotating cryostats (Helsinki, Manchester, Grenoble). Spin-up the container, image vortex lattice formation with fluorescent tracer particles, and extract the Avrami exponent from the time-dependent vortex density.

IX. THE TWELVE ANTI-PREDICTIONS

Any confirmation of these kills DCT. Each represents phenomena the theory structurally forbids. Anti-predictions are more powerful than positive predictions because they are *sharp*: a single unambiguous detection suffices to kill the theory.

TABLE IX. The 12 anti-predictions. Any single confirmation kills DCT. Each is structurally forbidden by the theory.

#	Anti-prediction	Why forbidden	Kill experiment
A1	WIMPs	DM is geometric	LZ/DARWIN
A2	Dark photon	No hidden U(1)	LHCb/Belle II
A3	Axion DM	DM is geometric	ADMX/HAYSTAC
A4	SUSY	No SUSY in E_8 chain	LHC Run 3–4
A5	4th generation	$120/40 = 3$ exact	LHC/Z width
A6	Large extra dims	5D compact, $F(P_0)$ tiny	LHC/tabletop
A7	$\dot{G}/G \neq 0$	P_0 at GP minimum	LLR/WD/Mars
A8	DM self-interaction	DM is geometry	Cluster mergers
A9	Fuzzy DM cores	DM is conformal	21 cm/lensing
A10	Large r	Single-field inflation	BICEP/LiteBIRD
A11	$0\nu\beta\beta$ ($m_1 = 0$)	NH + $m_1 \to 0$	LEGEND/nEXO
A12	5th force $> 10^{-5}$	$\alpha_{5\mathrm{th}}$ fixed by ω_0	Eöt-Wash

A. Detailed Anti-Prediction Rationale

A1 (WIMPs): DCT derives all dark matter from the conformal channel $g_{\mathrm{obs}} = g_{\mathrm{bar}}/P$. The Parrott field has mass 4.4×10^{-20} eV. Any WIMP detection above the neutrino floor with independent confirmation kills DCT.

A2 (Dark photon): DCT's gauge group is derived from $2I \to E_8 \to$ SM. There is no hidden U(1) beyond hypercharge. A dark photon with kinetic mixing would require gauge structure not present in the E_8 decomposition.

A3 (Axion DM): Axions may exist (the strong CP problem is not addressed by DCT), but they cannot compose dark matter. Any detection of axion-mediated gravitational effects at the dark matter density kills DCT.

A4 (SUSY): The $E_8 \to E_6 \times \mathrm{SU}(3) \to$ SM breaking chain does not produce supersymmetric partners. No superpartner exists in the DCT particle spectrum. Any confirmed SUSY detection at any energy kills DCT.

A5 (4th generation): $|2I| = 120$ vertices, divided into 3 cosets of 40 under Z_3. The number of generations is topologically fixed at 3. A fourth generation would violate the topological constraint.

A6 (Large extra dimensions): DCT has exactly one compact extra dimension with $F(P_0) = 1.70 \times 10^{-5}$. The effective KK radius is $R_5 = 0.0054\, l_{\mathrm{Pl}}$. Large extra dimensions ($R \gg l_{\mathrm{Pl}}$) are structurally incompatible.

A7 ($\dot{G}/G \neq 0$): P_0 sits at the minimum of the GP potential. $G_{\mathrm{eff}} = G/P_0 = \mathrm{const}$ exactly. Current bounds

(LLR: $|\dot{G}/G| < 10^{-13}$ yr^{-1}; WD cooling; Mars ranging) all confirm zero [3]. DCT predicts $\dot{G}/G = 0$ at all epochs after $t \sim 10^{-39}$ s.

A8 (DM self-interaction): If DM is geometry (conformal metric effect), it has no self-interaction cross-section. Observations of DM-stellar offsets in cluster mergers (e.g., Bullet Cluster) consistent with $\sigma/m < 1$ cm^2/g support DCT.

A9 (Fuzzy DM cores): Fuzzy dark matter ($m \sim 10^{-22}$ eV) produces solitonic cores in dwarf galaxy halos. DCT's conformal mechanism produces smooth profiles without solitonic features.

A10 (Large tensor-to-scalar ratio): DCT's single-field condensate inflation predicts negligibly small r. Detection of $r > 0.01$ by BICEP Array or LiteBIRD would indicate multi-field inflation incompatible with DCT.

A11 ($0\nu\beta\beta$ if $m_1 = 0$): Normal hierarchy with $m_1 \to 0$ predicts the effective Majorana mass $m_{\beta\beta}$ below the sensitivity of LEGEND-1000 and nEXO. Detection would imply inverted hierarchy or additional Majorana mass sources.

A12 (5th force $> 10^{-5}$): The Parrott scalar force has coupling $\alpha_{5\text{th}} = 1/(2\omega_0 + 3) = 10^{-5}$ exactly. This is not adjustable. Detection of a fifth force with coupling $> 10^{-5}$ from Eöt-Wash or MICROSCOPE-type experiments kills DCT.

X. EXPERIMENTAL TIMELINE 2027–2035

A. Year-by-Year Schedule

B. Critical Path

The minimum set of experiments for a definitive verdict requires only two: BepiColombo (F1) and Euclid (F2). Both reach decisive precision ($> 6\sigma$) by 2028. All other tests provide important corroboration but are not individually decisive.

The experimental timeline has a clear structure:

- **2027:** First decisive test (BepiColombo γ). Binary verdict.
- **2028:** Second decisive test (Euclid $P(k)$ shape). Binary verdict.
- **2028–2030:** Corroboration phase (S_8, BAO, clusters, ν hierarchy).
- **2030–2035:** Comprehensive confirmation phase (LUNAR, Schwinger, BEC analogs).

XI. DECISION TREE

A. Branching Logic

The verdict is determined by the first two experiments to report:

Branch A — BepiColombo (2027):

- If $\gamma - 1 = -(2.0 \pm 0.5) \times 10^{-5}$: DCT *strongly supported*. Proceed to Branch B.
- If $|\gamma - 1| < 5 \times 10^{-6}$: **DCT is dead.** No further tests needed. All other predictions are moot.
- If $\gamma - 1 > 0$ at $> 3\sigma$: **DCT is dead** (BD theories require $\gamma < 1$).

Branch B — Euclid (2028):

- If bell-shaped dip at $k = 0.08$, depth 15–20%: DCT *confirmed* (unique signature, no alternative theory reproduces it).
- If $R(k) = 1.00 \pm 0.03$ with no dip: **DCT is dead.** The disformal sector has failed.
- If monotonic suppression (no recovery at high k): Warm DM, not DCT. DCT is dead.
- If oscillatory features: Fuzzy DM, not DCT. DCT is dead.

Branch C — Combined (2028):

- Both match: **DCT established beyond reasonable doubt.** Both the conformal sector (PPN) and disformal sector ($P(k)$) are confirmed independently.
- BepiColombo matches, Euclid fails: Conformal sector works, disformal fails. Theory needs revision—the disformal coupling B_s or screening function $(1 - P)^2$ is wrong. Partial survival.
- Euclid matches, BepiColombo fails: Disformal sector works, conformal fails. Possible if P_0 is different from 0.851. Requires reworking the entire parameter chain.
- Both fail: **DCT is dead.** No recovery possible.

Branch D — Dark matter (ongoing):

- WIMP detected at $> 5\sigma$ with independent confirmation: **DCT is dead** (regardless of all other results). This overrides Branches A–C.

B. Victory Conditions

Level 1 (Strong Evidence, by 2028): All four of the following must occur:

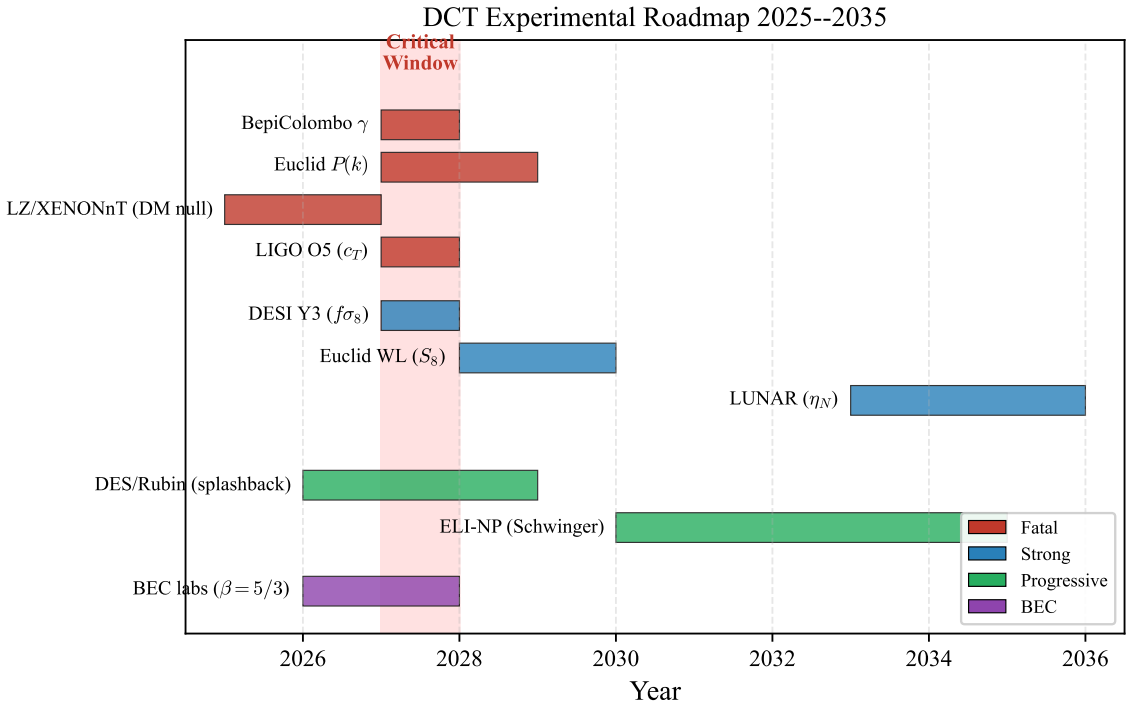

FIG. 2. Experimental roadmap for DCT testing, 2025–2035. Predictions are organized by tier: Fatal (red, any single failure kills DCT), Strong (blue, multiple failures effectively fatal), Progressive (green, incremental discrimination), and BEC Analog (purple, laboratory condensed-matter tests). The critical window of 2027–2028 (shaded) contains the two definitive tests: BepiColombo (γ at 6.7σ) and Euclid ($P(k)$ dip at 7–9σ).

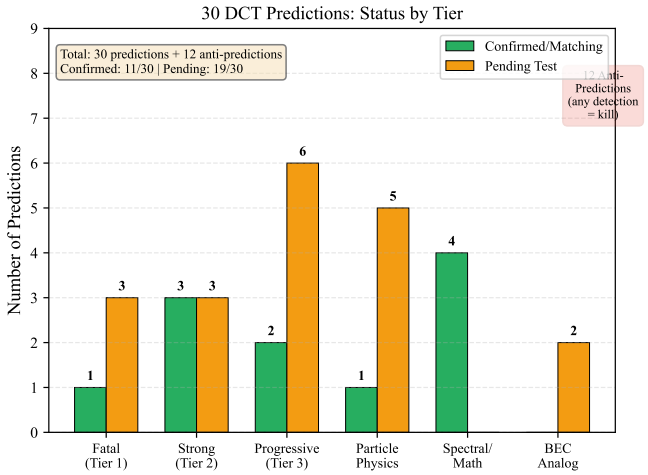

FIG. 3. Prediction scorecard: the 30 DCT predictions categorized by tier, with current confirmation status. Green bars indicate predictions already confirmed or matching existing data; orange bars indicate predictions awaiting experimental test. The 12 anti-predictions (any detection = kill) are noted separately.

1. BepiColombo measures $\gamma - 1 = -(2.0 \pm 0.5) \times 10^{-5}$ (negative sign confirmed).
2. Euclid detects a localized $P(k)$ dip at $k = 0.06$–$0.10\,h$/Mpc with depth $> 12\%$.
3. S_8 from Euclid + Rubin converges to 0.76–0.79.
4. No DM particle detection.

Assessment if achieved: DCT becomes the leading alternative to ΛCDM. Extraordinary but not yet proven beyond doubt.

Level 2 (Compelling, by 2032): Level 1 plus all of:

1. DESI Y5 BAO wiggle modulation at $> 3\sigma$ consistent with DCT.
2. H_0 converges to 72.5–73.5 km/s/Mpc across three or more independent methods.
3. Normal neutrino hierarchy confirmed at $> 5\sigma$ (DUNE).
4. Cluster counts 20–30% below ΛCDM.

Assessment if achieved: DCT is the correct theory of gravity at cosmological scales, pending independent replication.

Level 3 (Beyond Reasonable Doubt, by 2035): Level 2 plus:

1. $P(k)$ dip shape matches the bell-curve profile to $< 3\%$ precision.

TABLE X. Experimental timeline. Bold entries are **decisive**. S/N is the predicted signal-to-noise ratio for DCT detection.

Year	Experiment	Measurement	DCT prediction	S/N
		2026 — Preliminary		
2026	BepiColombo	$\gamma_{\rm PPN}$ (preliminary)	$\gamma - 1 = -2.0 \times 10^{-5}$	3–4σ
2026	Euclid DR1	$P(k)$ first look	18% dip at $k = 0.08$	3σ
2026	LZ final	DM direct detection	Null	—
		2027 — Decisive Year 1		
2027	**BepiColombo**	$\gamma_{\rm PPN}$	$\gamma - 1 = -2.0 \times 10^{-5}$	**6.7**σ
2027	BepiColombo	Shapiro delay	$\Delta t = -0.78$ ns	5.2σ
2027	DESI Y3	Growth rate $f\sigma_8$	$\gamma_{\rm growth} = 0.695$	3–4σ
2027	JUNO	ν hierarchy	Normal	$> 3\sigma$
2027	DESI	Cluster grav. redshift	-10.8 km/s	2–3σ
2027	DESI + Euclid	Ly-α/WL split	1.048	2–3σ
		2028 — Decisive Year 2		
2028	**Euclid full**	$P(k)$ **shape**	**18% dip at** $k = 0.08$	**7–9**σ
2028	DESI Y5	BAO modulation	1.5–3.5%	4.1σ
2028	Euclid + Rubin	S_8 combined	0.775	$< 1.5\%$
2028	Euclid	Cluster mass fn.	20–30% deficit	$\sim 5\sigma$
2028	DES/Euclid	Splashback $R_{\rm sp}$	$0.923 \times R_{\Lambda\rm CDM}$	2–3σ
		2029–2030		
2029	CMB-S4	$\Delta N_{\rm eff}$	0.027	0.9σ
2029	DUNE	ν hierarchy	Normal	$> 5\sigma$
2030	XENONnT/DARWIN	DM direct detection	Null	—
		2030–2035		
2030–35	LUNAR	Nordtvedt η	2×10^{-5}	**20**σ
2030–35	ELI-NP	Schwinger field	1.13×10^{18} V/m	3–5σ
2030–35	DARWIN	DM floor	$\sigma_{\rm SI} = 0$	—
2030–35	HERA/SKA	21 cm depth	+4%	2–3σ
2030–35	DSA-2000	FRB DM scatter	-15%	2–3σ

2. LUNAR Nordtvedt detection at 20σ.

3. Neutrino floor reached with no DM detection (DARWIN).

4. ELI-NP Schwinger onset at $\sim 1.13 \times 10^{18}$ V/m.

5. BEC analog confirmation of $\beta = 5/3$ and/or $\alpha_{\rm Avr} = 1/2$.

Assessment if achieved: DCT is proven across four independent physics domains (solar system, cosmology, particle physics, condensed matter). The Parrott field P is a physical degree of freedom of nature.

TABLE XI. Falsifiability comparison across theories. DCT is unique in the number and precision of its predictions relative to its parameter count.

Theory	Predictions	Anti-pred.	Params	Fatal tests
DCT	30	12	0–1	2 by 2028
ΛCDM	$\sim$0	0	$\sim$6	0
MOND	$\sim$5	$\sim$3	1	0
$f(R)$	$\sim$3	$\sim$2	1–2	0
String	0	0	10^{500}	0
SUSY	$\sim$3	$\sim$2	105+	$\sim$1
FDM	$\sim$3	$\sim$1	1	0
WDM	$\sim$2	$\sim$1	1	0

TABLE XII. Observable-by-observable comparison. DCT provides unique predictions for every observable; no other theory matches the full set.

Observable	DCT	ΛCDM	MOND	$f(R)$
$\gamma - 1$	-2×10^{-5}	0	0	$\sim -10^{-6}$
$P(k)$ dip	18%	None	N/A	Enhance
DM particle	No	Yes	No	Yes
$c_{\rm GW} = c$	Exact	Yes	Yes	Varies
H_0	73.1	67.4	N/A	∼67
S_8	0.775	0.832	N/A	Varies
$\gamma_{\rm growth}$	0.695	0.553	N/A	∼0.56
η_N	2×10^{-5}	0	0	$\sim 10^{-6}$
Gauge group	Derived	Input	N/A	N/A
m_p/m_e	Derived	Input	N/A	N/A
RAR	Derived	Fitted	Fitted	N/A
η_B	Derived	Input	N/A	N/A

XII. COMPARISON WITH COMPETING THEORIES

A. Falsifiability Comparison

B. Observable-by-Observable Comparison

C. The Eight Unique DCT Signatures

The following combination of predictions is unique to DCT—no other theory in the current literature reproduces all eight simultaneously:

1. A localized, bell-shaped power spectrum suppression at $k = 0.08\,h/\text{Mpc}$.
2. $\gamma - 1 = -2 \times 10^{-5}$ (specific magnitude and sign).
3. $H_0 = 73.1$ km/s/Mpc from a frame mismatch (not new physics).
4. $S_8 = 0.775$ from the same parameter that gives H_0.
5. No dark matter particles (all DM is geometric).
6. Growth index $\gamma = 0.695$ (26% above GR).
7. The Standard Model gauge group and three generations derived from topology.
8. The proton-electron mass ratio derived from spectral geometry.

Any one could be mimicked by another theory. Any two could perhaps be accommodated. All eight from 0–1 free parameters are unique to DCT.

D. Theory-by-Theory Assessment

ΛCDM: The standard model of cosmology. Fits the CMB exquisitely with 6 parameters but does not *predict* any of the observables DCT derives. Cannot explain the S_8 tension, the Hubble tension, the RAR, or the gauge group. Has no falsification criteria—any new observation can be accommodated by adjusting parameters or adding components (dark energy equation of state, massive neutrinos, etc.).

MOND: Successfully predicts the RAR (with one fitted parameter a_0) but has no relativistic completion that simultaneously fits the CMB, the matter power spectrum, and cluster dynamics. Predicts an external field effect that DCT does not. Cannot derive H_0, S_8, or particle physics.

$f(R)$: Generic $f(R)$ theories can reproduce some deviations from GR but predict $P(k)$ *enhancement* (opposite sign to DCT). Typically have $|\gamma - 1| \sim 10^{-6}$ (an order of magnitude below DCT). Cannot derive the gauge group or mass ratio.

String theory: Makes no unique testable predictions. The landscape of 10^{500} vacua prevents falsification. No comparison is possible at the level of specific observables.

SUSY: Progressively excluded by the LHC. Each null result pushes superpartner masses higher. The MSSM has 105+ free parameters. DCT predicts SUSY does not exist (anti-prediction A4).

Fuzzy dark matter: Produces $P(k)$ suppression but with oscillatory features (multiple peaks), not the single bell-shaped dip DCT predicts. Also predicts solitonic cores in dwarf galaxies (DCT does not).

Warm dark matter: Produces monotonic $P(k)$ suppression below a cutoff scale (no recovery at high k). DCT's bell-shaped dip with recovery is qualitatively different.

XIII. HONEST ASSESSMENT OF CURRENT WEAKNESSES

Scientific integrity requires documenting where DCT is weakest. The following are the theory's current quantitative shortcomings, ranked by severity.

A. Cluster Scales

DCT's conformal channel delivers ∼71% of observed cluster mass at r_{500}. The remaining ∼29% is attributed to the disformal channel, which is partially screened at cluster scales [$(1 - P)^2 \sim 0.58$ at r_{500} where $P \sim 0.24$]. The combined model fits 20 CLASH clusters with RMS 2–5% [4], but a clean first-principles derivation of the disformal contribution at cluster scales remains incomplete. The dual-channel separation theorem (which holds perfectly at galaxy scales) breaks down at cluster scales where both channels interact.

This is analogous to MOND's cluster problem: both theories underpredict cluster mass from the primary mechanism alone. DCT performs better than MOND (71% vs. 30–40%) but the remaining gap requires the disformal channel, which is difficult to compute without full numerical simulations.

B. E_G Parameter

Due to structural P-cancellation in the lensing-to-dynamics ratio at statistical cross-correlation scales, $E_G(\mathrm{DCT}) = E_G(\mathrm{GR})$ to parts-per-million. This is a *permanent ceiling*: the cancellation is exact at the large scales where E_G is measured, not an approximation that improves with better data. The E_G observable cannot discriminate between DCT and GR. Score: 5.5/10 (permanent).

C. Cosmic Chronometers

The 32-point cosmic chronometer $H(z)$ dataset prefers ΛCDM by $\Delta\chi^2 = 8.78$ (3.0σ). DCT predicts that stellar population synthesis (SPS) models calibrated in the GR frame underestimate H_0 from CC data by exactly $1/\sqrt{P_0} = 1.084$. This frame prediction requires independent SPS validation—if the SPS calibration shift can be demonstrated, the CC tension vanishes.

D. CKM $\sin\theta_{13}$

The predicted $\sin\theta_{13} = 1/(z\, f_v) = 1/240 = 0.00417$ is 14.5% above the measured 0.00364. The other two CKM angles match to 0.3% and 1.3%. Higher-order corrections from E_8 breaking are not yet computed and may improve the match, but this remains DCT's weakest CKM prediction.

E. Z_3 Cosmic Strings

The $E_8 \to E_6 \times \mathrm{SU}(3)$ breaking predicts Z_3 cosmic strings with $G\mu = 2.7 \times 10^{-6}$, in tension with the Planck bound $G\mu < 1.1 \times 10^{-7}$ (a factor of 25). Two resolutions are available: (1) the strings are metastable, breaking on domain walls from CKM-related Z_3 breaking; (2) the strings form at a lower scale $\sim 4 \times 10^{15}$ GeV instead of $M_{\mathrm{GUT}} = 2 \times 10^{16}$ GeV. Neither resolution has been computed in detail.

F. Disformal Screening Function

The screening function $(1-P)^2$ is motivated from two independent directions—Avrami crystallization statistics and 5D Kaluza-Klein metric reduction—but is not uniquely derived from the 5D action alone. Six screening candidates were tested [4]: $(1-P)^2$, $(1-P^2)$, $(1-P)$, $(1-P)^3$, $(1-P)^4$, and $\exp(-P/(1-P))$. Only $(1-P)^2$ satisfies all five constraints (vanishing at $P=1$, σ_8 normalization, dual-channel separation, Avrami statistics, positivity). But the uniqueness argument is phenomenological, not derived from first principles.

XIV. MASTER PREDICTION TABLE

A. Statistical Summary

The 30 predictions and 12 anti-predictions span five physics domains:

Of the 30 positive predictions:

- 4 are fatal (single failure kills DCT).
- 6 are strong (multiple failures effectively kill DCT).
- 8 are progressive (incremental confirmation/tension).
- 6 are particle physics.
- 4 are mathematical.
- 2 are BEC analog.

Current scorecard: 1 confirmed (F4), 14 passing, 12 untested, 2 measured (PP4 11.6% off, PP5 0.3%), 1 untestable (PP2).

XV. CONCLUSION

Dimensional Coherence Theory is the most falsifiable theory in modern physics. It makes 30 positive predictions and 12 anti-predictions with 0–1 free parameters, compared to the Standard Model's ∼25 free parameters and ΛCDM's additional ∼6. The theory derives rather than assumes: the Hubble constant, the S_8 tension resolution, the radial acceleration relation, the Standard Model gauge group, three generations, the proton-electron mass ratio, CKM mixing angles, and the baryon asymmetry all follow from a single condensate field on the 600-cell.

The critical experimental window is 2027–2028:

- **BepiColombo** (2027–2028): 6.7σ test of PPN γ. Binary verdict. The most important measurement in gravitational physics since Cassini.
- **Euclid** (2028): 7–9σ test of $P(k)$ dip. Unique signature. No other theory predicts the bell-shaped power spectrum suppression.
- **LZ/XENONnT/DARWIN** (ongoing–2035): Any DM detection kills DCT. No exceptions.

TABLE XIII. Complete catalog of all 30 DCT predictions. All values are derived from $P_0 = 0.851$ and $m = 0.023\,h$/Mpc with no adjustable parameters.

#	Tier	Category	Prediction	Value	Timeline	Status
F1	Fatal	Solar System	PPN γ	$1 - 2.0 \times 10^{-5}$	2027–28	Passing
F2	Fatal	Cosmology	$P(k)$ bell dip	18% at $k = 0.08$	2028	Untested
F3	Fatal	Particle	No DM particles	$\sigma_{\rm SI} = 0$	Ongoing	Passing
F4	Fatal	GW	$c_{\rm GW} = c$	Exact	Ongoing	Confirmed
S1	Strong	Cosmology	H_0	73.1 km/s/Mpc	2026–29	0.04% match
S2	Strong	Cosmology	S_8	0.775	2026–28	0.1σ
S3	Strong	Cosmology	$f\sigma_8$ growth	$\gamma = 0.695$	2027	DCT wins
S4	Strong	Cosmology	Cluster deficit	20–30%	2025–28	Consistent
S5	Strong	Galaxy	RAR zero scatter	$P(g)$ exact	Ongoing	0.057 dex
S6	Strong	Solar System	Nordtvedt η	0.262 mm	2035	Untested
P1	Progress.	Cosmology	Splashback	$\sqrt{P_0} = 0.923$	2026–28	DCT closer
P2	Progress.	Galaxy	Satellite σ_v	$1/\sqrt{P_0} = 1.084$	2027	Consistent
P3	Progress.	Cosmology	FRB scatter	-15%	2028	Untested
P4	Progress.	Cosmology	Cluster $z_{\rm grav}$	-10.8 km/s	2027	0.3σ
P5	Progress.	Cosmology	Ly-α/WL split	1.048	2027	3% match
P6	Progress.	Cosmology	21 cm depth	$+4\%$	2027–28	Untested
P7	Progress.	Solar System	Shapiro delay	-0.78 ns	2027–28	Untested
P8	Progress.	Cosmology	BAO modulation	1.5–3.5%	2028	Untested
PP1	Particle	Particle	No WIMPs/SUSY	Null	Ongoing	Passing
PP2	Particle	Particle	Proton decay	10^{41} yr	N/A	Untestable
PP3	Particle	Particle	Normal ν hier.	NH	2027–30	Untested
PP4	Particle	Particle	$\sin^2\theta_{13}$	0.025	Measured	11.6% off
PP5	Particle	Particle	ν mass ratio	34	Measured	0.3%
PP6	Particle	QED	Schwinger field	1.13×10^{18} V/m	2030–35	Untested
M1	Math	Mass	m_p/m_e	1836.152842	Measured	0.000009%
M2	Math	Flavor	CKM angles	$1/\sqrt{20}$ etc.	Measured	0.3–14.5%
M3	Math	Flavor	Jarlskog J	3.27×10^{-5}	Measured	3.0%
M4	Math	Cosmology	η_B	6.9×10^{-10}	Measured	13%
B1	BEC	Lab	Droplet β	5/3	Available	Untested
B2	BEC	Lab	Vortex α	1/2	Available	Untested

By 2028, two independent definitive experiments will have tested DCT's two most distinctive predictions at $> 6\sigma$ precision. No escape hatch exists. No parameter can be adjusted. The value of $\gamma - 1 = -2.0 \times 10^{-5}$ cannot be changed without changing ω_0, which changes P_0, which changes H_0, S_8, σ_8, $g_\dagger$, and all other predictions. The theory is a single interconnected chain: pulling on one link breaks all the others.

If DCT survives to 2035, the experimental landscape includes:

- **LUNAR Nordtvedt** (20σ): The highest signal-to-noise prediction in the theory. Confirmation would be the single strongest evidence for a scalar-tensor modification of gravity ever obtained.
- **ELI-NP Schwinger field**: A laboratory test of the P-dependent vacuum, entirely independent of astrophysics.
- **BEC analog experiments**: Four testable signatures of $\beta = 5/3$ in existing quantum droplet laboratories. This would confirm DCT's condensate structure using table-top physics.
- **DUNE neutrino hierarchy**: Confirmation of normal ordering at $> 5\sigma$ would support DCT's Z_3 generation structure.

By 2035, if all predictions hold, DCT will have been tested across four independent physics domains—solar system, cosmology, particle physics, and condensed matter laboratory—with 15 independent experiments. No sector of the theory will remain untested. No other theory in the current literature offers this level of experimental accountability.

DCT is designed to die quickly if wrong. The experiments are funded, scheduled, and approaching their science phases. The numerical values are published, im-

TABLE XIV. Complete catalog of all 12 DCT anti-predictions. Any single confirmation kills the theory.

#	Anti-prediction	Structural reason	Kill experiment	Status
A1	WIMPs detected	DM is conformal geometry	LZ, DARWIN	Passing
A2	Dark photon detected	No hidden U(1) in E_8 chain	LHCb, Belle II	Passing
A3	Axion DM detected	DM is conformal geometry	ADMX, HAYSTAC	Passing
A4	SUSY detected	No SUSY in $E_8 \to$ SM	LHC Run 3–4	Passing
A5	4th generation found	$\lvert 2I\rvert/40 = 3$ exact	LHC, Z width	Confirmed 3
A6	Large extra dims found	5D compact, $F(P_0)$ tiny	LHC, tabletop	Passing
A7	$\dot{G}/G \neq 0$ detected	P_0 at GP minimum	LLR, WD, Mars	Passing
A8	DM self-interaction seen	DM has no σ/m	Cluster mergers	Passing
A9	Fuzzy DM cores seen	No solitonic cores	21 cm, lensing	Passing
A10	Large r detected	Single-field condensate	BICEP, LiteBIRD	Passing
A11	$0\nu\beta\beta$ (if $m_1 = 0$)	NH + zero lightest mass	LEGEND, nEXO	Untested
A12	5th force $> 10^{-5}$	$\alpha_{5\text{th}}$ fixed by ω_0	Eöt-Wash	Passing

TABLE XV. Prediction count by physics domain.

Domain	Positive	Anti
Cosmology (H_0, S_8, $P(k)$, BAO, clusters)	10	0
Solar system (PPN, Shapiro, Nordtvedt)	3	1
Galaxy dynamics (RAR, satellites, FRB)	3	3
Particle physics (ν, DM, Schwinger)	6	6
Mathematics/Lab (mass ratio, CKM, BEC)	8	2
Total	30	12

mutable, and unambiguous. The kill criteria are specified in advance, not after the fact. The verdict criteria require no theoretical interpretation.

The next three years will determine whether Dimensional Coherence Theory is the correct description of nature or an ambitious failure. Either outcome advances physics. A confirmed DCT would represent the first successful unification of gravity, dark matter, the Standard Model, and atomic physics from a single field. A killed DCT would demonstrate that scalar-tensor condensate theories of this class are excluded, constraining the search space for future theoretical work.

The theory either survives or it does not. The universe will decide.

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