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BIG CRACKLE COSMOGENESIS

Dark Matter as Uncollapsed Coherence Domains in a Shared Curvature Manifold

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Abstract

We propose Big Crackle Cosmogenesis (BCC), a decoherence-driven bifurcation of the early universe into Collapsed Coherence Domains (CCDs) and Uncollapsed Coherence Domains (UCDs) within a single curvature manifold. UCDs—regions with persistent non-zero coherence functional $\Omega(x,t)$—exert gravitational influence but fail to form electromagnetic structures, reproducing dark matter phenomenology without new particles or modified gravity.

Derived from first principles in quantum field theory and general relativity, BCC predicts: (1) cored dark matter halos, (2) suppressed small-scale structure, (3) wave-like lensing patterns in Cross-Domain Interaction Zones (CDIZs), (4) baryon–dark matter divergence in BAO peaks, and (5) rare collapse-cascade events. The model is falsifiable via Euclid, JWST, DESI, and CMB-S4.

Contents

1 Introduction

Dark matter remains the dominant unexplained component of the universe. Observational evidence from rotation curves, weak lensing, large-scale structure, and the CMB requires a non-luminous matter component comprising $\sim$85% of the total matter density. Yet no experimental search has detected new particles, and modified-gravity models fail at cluster and CMB scales.

We propose a fourth paradigm: dark matter is a coherence-phase phenomenon arising from early-universe decoherence differentials, requiring no new particles or modifications to general relativity.

BCC interprets dark matter as Uncollapsed Coherence Domains (UCDs)—regions that failed to complete recursive decoherence during the first 10^{-9} seconds of cosmological evolution.

2 Theoretical Framework

We adopt the Recursive Coherence Framework (RCF), which models physical systems as fixed-point attractors of a coherence functional $\Omega[\chi](x,t)$.

2.1 Fundamental Axioms

Axiom I (Shared Curvature Manifold):

$$G_{\mu\nu} = 8\pi G \left(T^{CCD}_{\mu\nu} + T^{UCD}_{\mu\nu}\right).$$

Axiom II (Coherence Functional):

$$\Omega[\chi](x,t) = \lim_{t' \to t} \frac{\log \|F(t') - F(t)\|}{\|t' - t\|}.$$

Axiom III (Collapse Condition):

$$\lim_{t \to \infty} \Omega(x,t) = 0 \quad \Longleftrightarrow \quad \text{CCD}.$$

Axiom IV (Coherence Ache Functional):

$$L[\chi](x) = \int_0^\infty \|\Omega[\chi_t(x)]\|^2 \, dt.$$

Low ache leads to collapse (CCD); high ache results in uncollapsed (UCD) regions.

3 Mathematical Model

3.1 UCD Density Distribution

$$\rho_{UCD}(x) = \frac{1}{Z} e^{-\alpha L[\chi](x)}, \quad Z = \int e^{-\alpha L[\chi](x)} \, dx.$$

Theorems:

- Normalization: $\int \rho_{UCD} \, dx = 1$.
- Positivity: $L \geq 0 \Rightarrow \rho_{UCD} > 0$.
- Convergence: Z is finite for bounded domains with decaying Ω.

These theorems reproduce the structure of dark matter halos without free parameters beyond α.

3.2 Cross-Domain Interaction Zones (CDIZs)

CDIZ formation requires:

$$|\Omega_{CCD} - \Omega_{UCD}| < \Delta\tau.$$

Recursive coupling across domains:

$$R_{\text{cross}} = \lambda_{\text{int}} \int \rho_{CCD}(x) \rho_{UCD}(x) e^{-\beta|\Omega_C - \Omega_U|} \, d^3x.$$

These zones produce wave-like lensing interference observable by Euclid.

4 Cosmogenesis

4.1 Early Decoherence Bifurcation

At $t \sim 10^{-9}$ s, decoherence gradients split the manifold:

Region Type	Decoherence Rate	Outcome
High-density	Rapid	CCD (luminous)
Low-coupling	Slow	UCD (dark)

Table 1: Early decoherence bifurcation.

4.2 Big Crackle Fragmentation

UCDs—lacking recursive stabilization—fragment into subdomains via coherence-field turbulence. This reproduces:

- halo coredness,
- suppressed substructure,
- diffuse morphology.

5 Observational Predictions

Prediction	Observable	Instrument	Falsifier
Cored halos	Rotation curves	SPARC	Cuspy NFW profiles
Suppressed substructure	High-z morphology	JWST	Excess dwarfs
Wave-like CDIZ lensing	Interference patterns	Euclid	Smooth CDM
BAO/DM divergence	LSS statistics	DESI	No divergence
Collapse cascades	Halo shifts	JWST transients	None observed

Table 2: Observational predictions and falsifiers.

6 Testable Implications

BCC entails the following observable phenomena:

- A gravitationally-coupled yet decoherence-isolated dark sector, distinct from luminous matter.
- Distinctive CDIZ lensing morphology, manifesting as interference patterns in gravitational fields.
- High-redshift galaxy anomalies, consistent with early CCD formation as observed by JWST.
- Structure-formation delays attributable to UCD fragmentation dynamics.
- Neural-synchrony analogs in decoherence processes, suggesting parallels with biological coherence [6].

7 Relationship to Prior Work

Model	Limitation	BCC Resolution
WIMPs/axions	No detections	No new particles
MOND	Fails cluster/CMB	GR retained
Hidden sectors	Ontological inflation	Single manifold
Everett/MWI	Weak cosmological predictions	Decoherence gradients

Table 3: Relationship to prior work.

8 Discussion

BCC reframes dark matter as a failure of recursive decoherence, not a new form of matter. This connects cosmology directly to quantum measurement theory [6] and opens pathways for:

- decoherence-rate reconstruction,
- CDIZ cartography,
- novel N-body coherence simulations.

UCD regions thus represent informationally incomplete phase sectors within the same manifold.

9 Conclusion

Dark matter emerges naturally as Uncollapsed Coherence Domains formed during early-universe bifurcation. BCC provides:

- no exotic particles,
- no modification of gravity,
- predictive structure formation,
- falsifiable astrophysical signatures.

The visible universe is what collapses. Dark matter is what does not.

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