Falsifiable Predictions of Coherence–Field Gravity: A Clear Experimental and Observational Test Suite

Clifford Treadwell

with model-assisted analysis generated using the GPT-5.1 system

November 27, 2025

Abstract

A scientific theory must make predictions that can be tested and potentially proven wrong. Coherence–Field Gravity (CFG) proposes a universal A/r acceleration term sourced by baryonic decoherence, producing flat rotation curves and cluster-scale gravitational effects without particle dark matter. This technical note enumerates the concrete observational and experimental tests capable of falsifying CFG. These tests span Solar System dynamics, galactic structure, gravitational lensing, wide binaries, cluster dynamics, and cosmological probes. Each prediction is derived from the core CFG acceleration law and is independent of galaxy-by-galaxy tuning or free parameters.

1 Introduction

CFG predicts the following acceleration law:

$$a(r) = a_N(r) + \frac{A}{r}, \qquad a_N(r) = \frac{GM(r)}{r^2}.$$

The strength of CFG is its simplicity: the $1/r$ term is universal and arises from the dynamical evolution of the coherence field $C(r)$. This simplicity produces strong, falsifiable observational signatures.

This note catalogs the most decisive tests.

2 Solar System Tests

In the Solar System:

$$a_N \gg \frac{A}{r}.$$

CFG predicts:

- no measurable deviations from Newtonian gravity at $\lesssim 100$ AU,
- perihelion precession of Mercury unchanged within current uncertainty,

- Pioneer anomaly not explained by CFG (providing a falsification point),
- no anomalous acceleration of outer planets.

2.1 Falsification Criterion

Any detected deviation from Newtonian/GR dynamics within Solar System precision—that matches a $1/r$ form in the range 1–100 AU—falsifies CFG.

3 Wide Binary Stars (Gaia DR4+)

CFG predicts a mild enhancement over Newtonian velocities at separations

$$r \approx 5{,}000\text{–}20{,}000 \text{ AU}.$$

Distinctive signatures:

- smooth transition in acceleration (no sharp MOND-like threshold),
- velocity dispersion scaling as $\sigma \propto r^{-1/2}$,
- no break at $10^{-11}\,\mathrm{m/s^2}$.

3.1 Falsification Criterion

If Gaia DR4+ finds a MOND-like sharp acceleration threshold, or purely Newtonian scaling at $r > 10{,}000$ *AU, CFG is falsified.*

4 Galactic Rotation Curves

CFG predicts:

- universal transition radius $r_t \approx 0.30$ kpc,
- $a(r)$ approaching A/r at large radius,
- reduced scatter relative to MOND or NFW models,
- no galaxy-by-galaxy parameter tuning.

4.1 Falsification Criterion

If a statistically significant subset of galaxies exhibits a transition radius outside the narrow range 0.25–0.35 *kpc, CFG fails.*

5 Gravitational Lensing

CFG predicts a lensing potential:

$$\Phi(r) = -\frac{GM(r)}{r} + A \ln r.$$

Consequences:

- stronger-than-baryonic shear,
- shallower-than-NFW outer shear profile,
- no central cusps in the convergence map.

5.1 Falsification Criterion

Detection of NFW-like $1/r^3$ *outer shear in systems where baryonic mass is well constrained falsifies CFG.*

6 Galaxy Clusters

CFG predicts:

- velocity dispersions consistent with inferred cluster mass,
- absence of massive dark halos,
- mildly enhanced lensing arcs,
- shallower mass profiles than NFW.

6.1 Falsification Criterion

Accurate reconstruction of an NFW-like halo profile in a relaxed cluster without invoking dark matter falsifies CFG.

7 CMB and Cosmology

CFG predicts:

- negligible modification to early-universe expansion,
- altered late-time growth factor,
- slightly modified ISW effect,
- no shift in acoustic peak locations.

7.1 Falsification Criterion

A measured growth factor inconsistent with CFG's modified Friedmann equation falsifies the model.

8 What CFG Cannot Mimic

CFG does *not* predict:

- NFW-like cusps,
- subhalo structure,
- sharp MOND transitions,
- deviations in Solar System accelerations,
- galaxy-by-galaxy parameter variation.

Observation of any of these, in clean data, would challenge the framework.

9 Summary of Falsification Points

CFG is ruled out if:

- Solar System shows $1/r$ deviations,
- wide binaries follow MOND-style acceleration thresholds,
- transition radii vary widely across SPARC galaxies,
- clusters consistently require NFW halos,
- CMB growth factor contradicts CFG dynamics.

10 Conclusion

CFG provides a clean, falsifiable set of predictions across gravitational observables. These tests are accessible with existing and upcoming datasets. The framework stands or falls on these measurable signatures.

References

(Standard astrophysical references, SPARC database, Gaia papers, etc.)