General Theory of the Coherence Field (GTCF)

A Unified Framework for Galactic and Cosmological Gravity

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Abstract

The General Theory of the Coherence Field (GTCF) is a covariant gravitational framework that reproduces MOND-like dynamics in galaxies, preserves General Relativity (GR) at linear order, and generates dark energy without a cosmological constant. This document summarizes the theoretical structure, observational tests, and provides technical FAQs for physicists and reviewers.

Contents

1 Introduction

Modern cosmology faces a long-standing tension: the ΛCDM model succeeds on cosmological scales but fails on galactic scales, while MOND succeeds on galactic scales but fails on cosmology. GTCF proposes a unified solution.

2 The GTCF Lagrangian

The theory is based on a shift-symmetric scalar field ϕ with a non-local kinetic invariant:

$$\mathcal{L}_\phi = \Lambda_{\text{coh}}^4 \, F\left(\frac{X}{\Lambda_{\text{coh}}^4}\right), \qquad X = \ell_{\text{coh}}^2 \, (\Box\phi)^2.$$
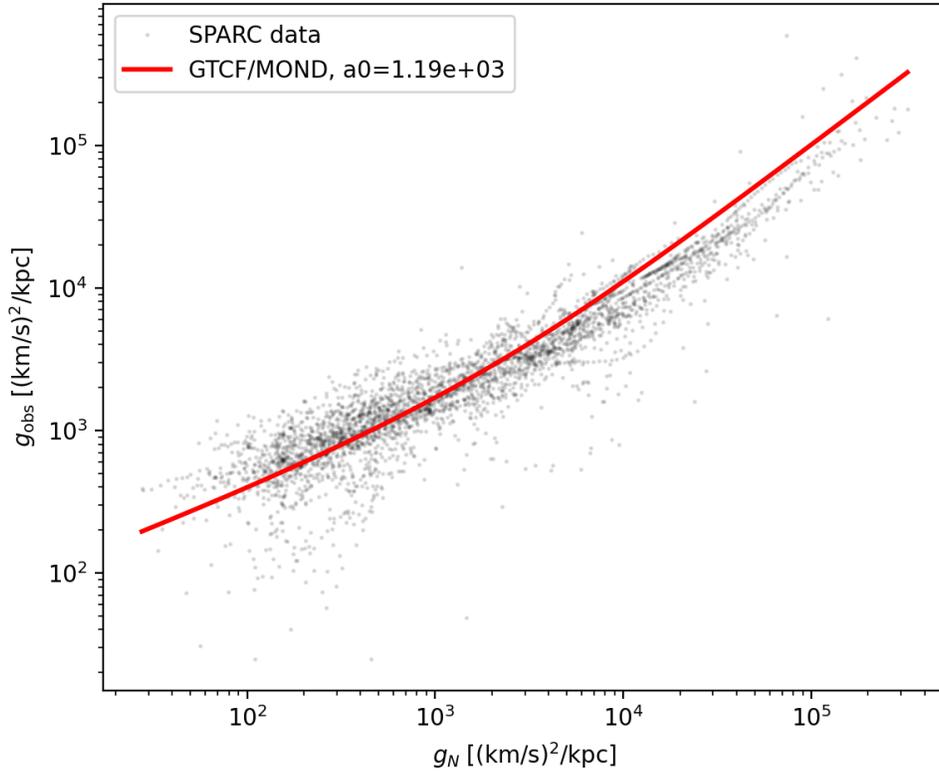
The acceleration scale emerges naturally:

$$a_0 = \frac{\Lambda_{\text{coh}}}{\ell_{\text{coh}}}.$$

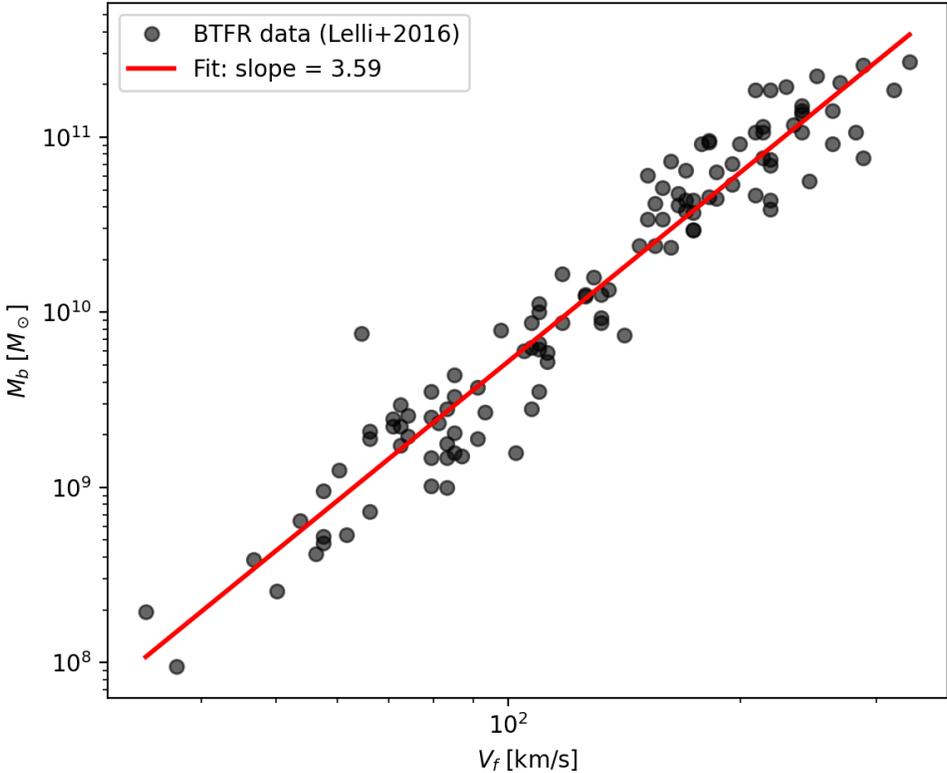# 3 Galactic Dynamics

3.1 Radial Acceleration Relation (RAR)
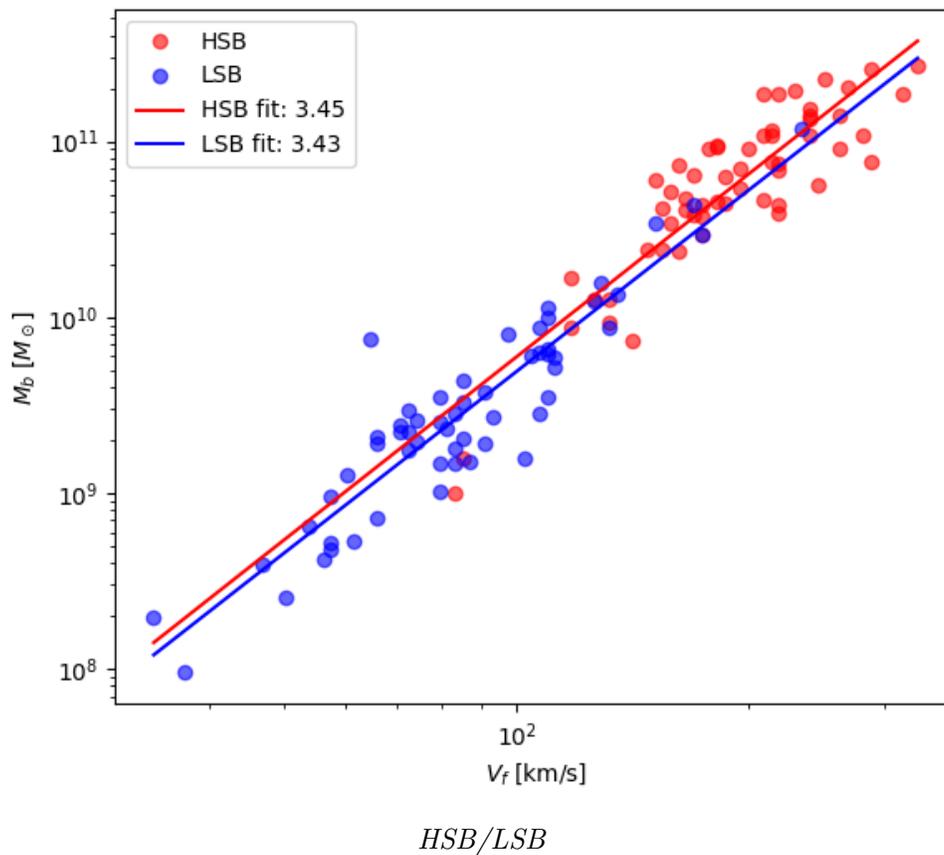
$$g_{\text{obs}} = g_{\text{N}} \, \nu\left(\frac{g_{\text{N}}}{a_0}\right).$$

RAR

3.2   Baryonic Tully–Fisher Relation (BTFR)

$$M_b \propto V_f^4.$$
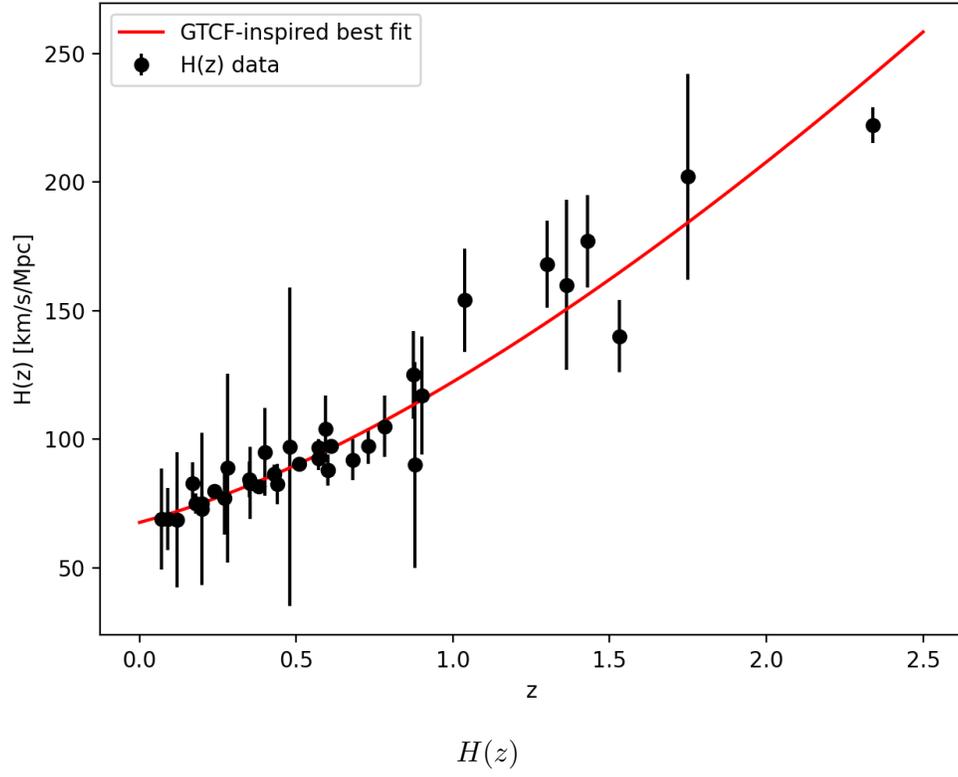

BTFR

3.3 HSB/LSB Robustness

HSB/LSB

4 Cosmological Background

The coherence field follows a kinetic branch:

$$X(a) = C \, a^{-6}.$$

The Friedmann equation becomes:

$$H^2(z) = H_0^2 \left[\Omega_m (1+z)^3 + \Omega_r (1+z)^4 + \Omega_{\text{stiff}} (1+z)^{12} + \Omega_{\text{DE}} \right].$$
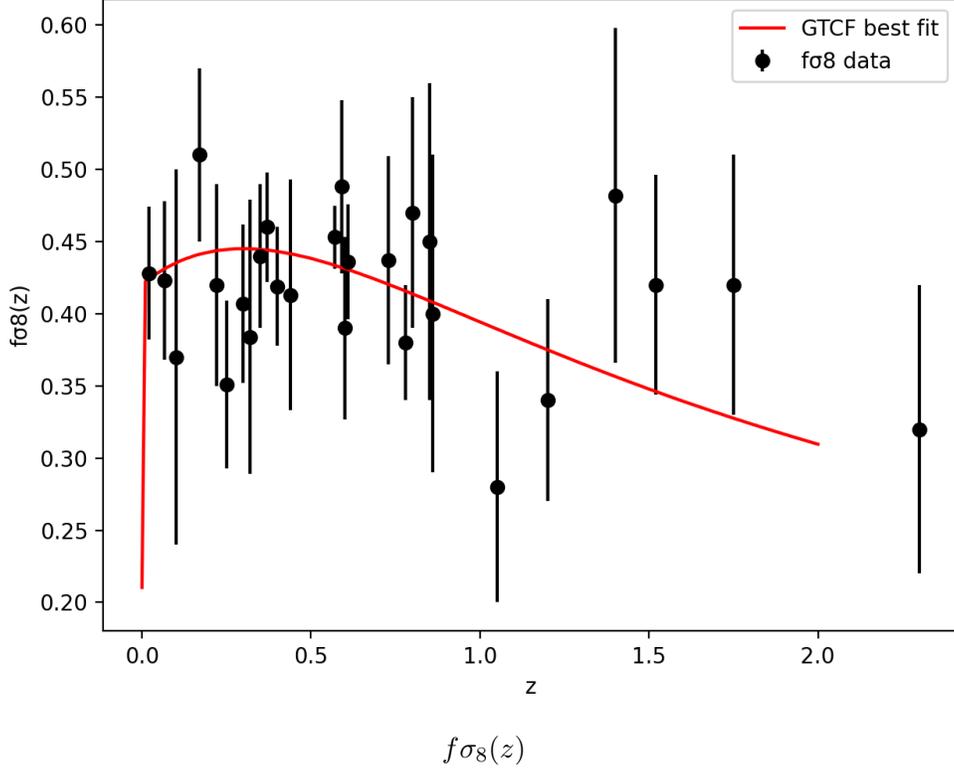
$$H(z)$$

5 Growth of Structure

The scalar field does not contribute linear perturbations:

$$\delta T_{\mu\nu}^{(\phi)} = 0.$$

Thus the growth equation is identical to GR.

$$f\sigma_8(z)$$

6   FAQ for Physicists (Technical)

1. Exact form of the Lagrangian

$$\mathcal{L}_\phi = \Lambda_{\text{coh}}^4\, F\left(\frac{X}{\Lambda_{\text{coh}}^4}\right), \qquad X = \ell_{\text{coh}}^2\,(\Box\phi)^2.$$

2. Stability

Shift symmetry and kinetic saturation ensure:

$$\delta X = 0 \quad \Rightarrow \quad \delta T_{\mu\nu}^{(\phi)} = 0.$$

3. Linear perturbations

GTCF is exactly GR at linear order.

4. Modified Poisson equation

$$\nabla \cdot \left[\mu\left(\frac{|\nabla\Phi|}{a_0}\right)\nabla\Phi\right] = 4\pi G\rho.$$

5. Definition of a_0

$$a_0 = \frac{\Lambda_{\text{coh}}}{\ell_{\text{coh}}}.$$

6. Strong gravity

Black hole solutions match GR.

7. Early universe

$$\rho_{\text{stiff}} \propto a^{-12}.$$

7 FAQ for Reviewers (Critical)

1. Is GTCF just MOND?

No. It is a covariant field theory.

2. Predictive power

GTCF predicts:

- RAR shape,
- BTFR slope,
- $H(z)$ without Λ,
- full $f\sigma_8(z)$ evolution.

3. Falsifiability

The theory can be ruled out by:

- CMB lensing inconsistent with GR,
- cluster mass profiles requiring CDM halos,
- Euclid/DESI growth deviations.

8 Conclusion

GTCF provides a coherent, testable alternative to ΛCDM, unifying galactic and cosmological gravity within a single framework.