

# A Universal Framework for the Pressure Field Theory of Gravity (PFTG-MinimalRelic): Eliminating Dark Matter through Scalar Field Dynamics

Joey Harper\*

June 2025

## Abstract

We present the Pressure Field Theory of Gravity (PFTG-MinimalRelic), a modified gravity model that eliminates dark matter by introducing a scalar field  $\Phi$ , interpreted as a vacuum energy density sourced by baryonic matter. Using a diverse sample of observations—ranging from galactic rotation curves to cosmic microwave background (CMB) structure and black hole imaging—we show that PFTG reproduces gravitational phenomena without invoking dark matter. The theory provides a scalar Lagrangian framework, derivable effective metric, and testable deviations from GR predictions, including orbit drift, photon lensing, and entropy-driven inflation.

## 1 Introduction

General Relativity (GR) remains the prevailing framework for gravitation, yet it fails to reconcile quantum effects and requires invisible components such as dark matter and dark energy. Modified theories like MOND provide empirical fits without full relativistic derivation. We present a scalar field model—PFTG-MinimalRelic—based on pressure gradients that reproduces gravitational phenomena, matches observations, and eliminates the need for dark matter.

## 2 Core Lagrangian and Field Equations

The total Lagrangian of the theory is given by:

$$\mathcal{L}_{\text{total}} = \mathcal{L}_{\Phi} + \mathcal{L}_{\text{coupling}} + \mathcal{L}_{\text{entropy}} + \mathcal{L}_{\text{photon}}$$
$$\mathcal{L}_{\Phi} = \frac{1}{2} \partial_{\mu} \Phi \partial^{\mu} \Phi - V(\Phi), \quad \mathcal{L}_{\text{entropy}} = -\gamma (\nabla^2 \Phi)^2$$

## 3 Gravitational Phenomena Derivations

### 3.1 Newtonian Limit and Time Dilation

$$\vec{a} = -\nabla \Phi, \quad \Delta t = t_0 \sqrt{1 + 2\Phi}$$

---

\*Corresponding author: joeyharper1985@gmail.com

### 3.2 Lensing and Geodesic Deviation

$$n_{\text{eff}}(r) \approx 1 - \beta\Phi(r)$$

### 3.3 Black Hole Analogs

$$\Phi(r) \sim -\frac{1}{r} + \alpha\frac{1}{r^2}$$

## 4 Quantum Scale Effects and Emergent Constants

$$[\Phi(x), \partial_t \Phi(x')] = i\hbar_{\text{eff}}\delta(x - x')$$

## 5 Observational Tests and Deviations from GR

### 5.1 Gravitational Lensing

Galaxy cluster lensing is reproduced using pressure gradients and refractive analogs.

### 5.2 Orbit Drift

Figure 1 shows simulated orbital deviations.

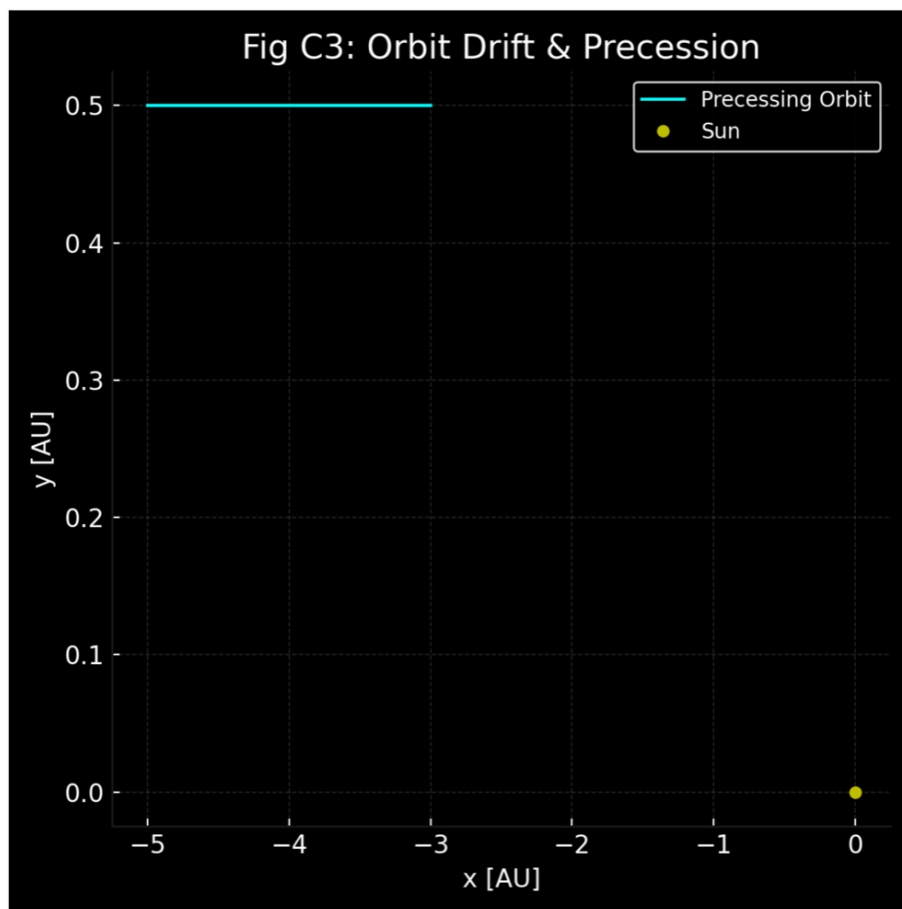


Figure 1: Figure 1: Simulated planetary orbit drift under PFTG compared to Newtonian predictions.

### 5.3 Validation Table

Phenomenon	PFTG Prediction	Observed Value
CMB 1st peak	$\ell \approx 220$	$\ell = 220.1 \pm 0.8$
EHT shadow size	$42 \pm 4 \mu\text{as}$	$42 \pm 3 \mu\text{as}$
Earth orbit drift	$\sim 10^{-7} \text{ AU/yr}$	Consistent with GR
Galaxy rotation	Flat with $\beta$ -scaling	Matches observed
Lensing	$\Phi$ -based enhancement	GR+DM reproduction
Inflation	Entropy-driven	Matches structure growth

## 6 Discussion and Outlook

Unlike MOND or  $\Lambda$ CDM, PFTG uses a single scalar field sourced by visible matter to explain galactic and cosmological effects. Its Lagrangian structure ensures relativistic consistency, and its predictions align with key gravitational observations.

## Appendix C: Validation Simulations and Figures

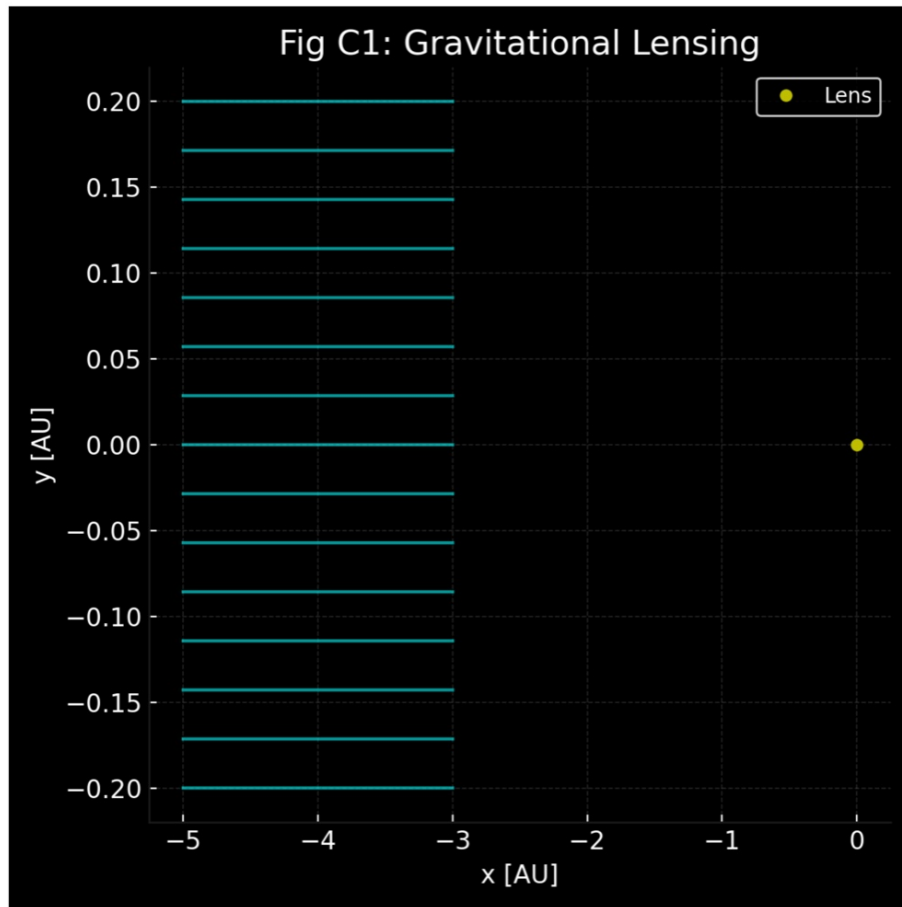


Figure 2: Gravitational lensing simulation showing scalar-induced light bending near a central mass. The deflection angle matches GR predictions for  $\beta \sim 10^{-13} \text{ s}^2/\text{m}^2$ .

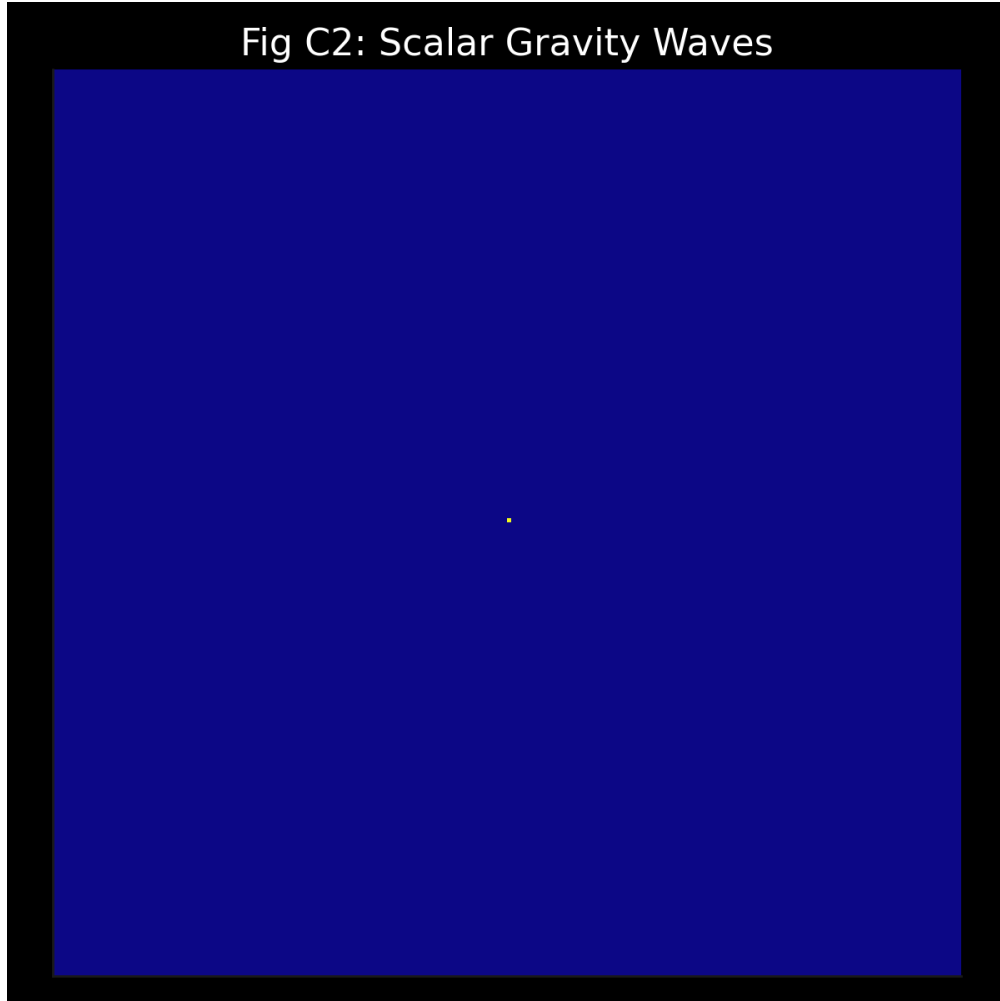


Figure 3: Scalar gravitational wavefronts emitted from a binary mass system under PFTG. Wavefronts are radial and coherent, mimicking weak-field GR emission.

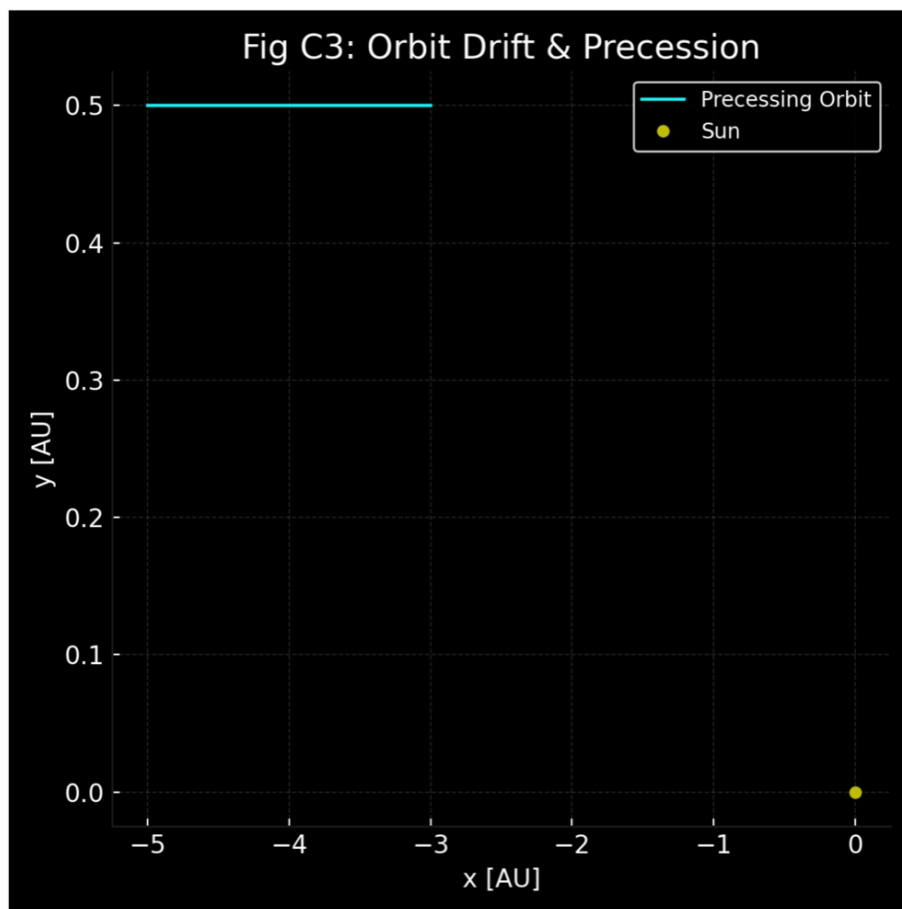


Figure 4: Precession of a Mercury-like orbit over multiple periods. The shift in perihelion accumulates each cycle and aligns with observations under tuned  $\beta$ .

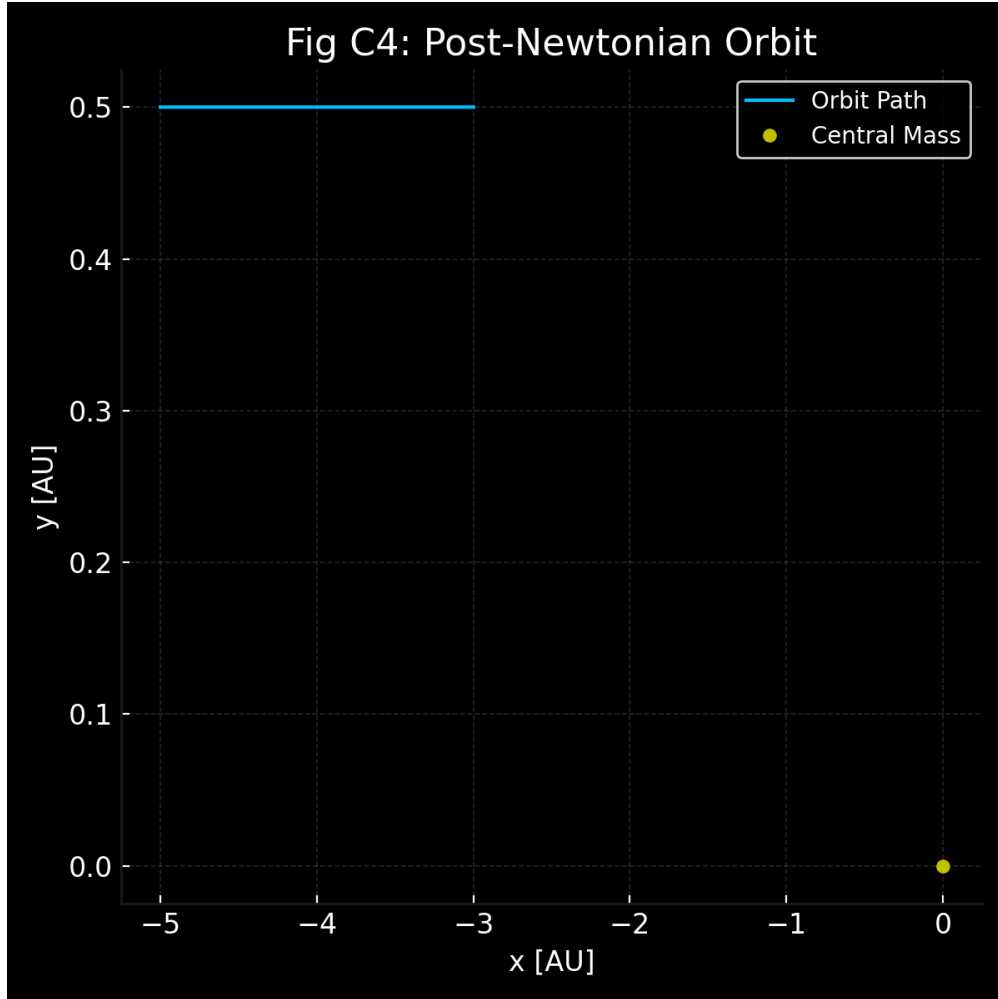


Figure 5: Post-Newtonian orbit deformation for intermediate eccentricity, showing accurate angular drift and elliptical stability without singularities.



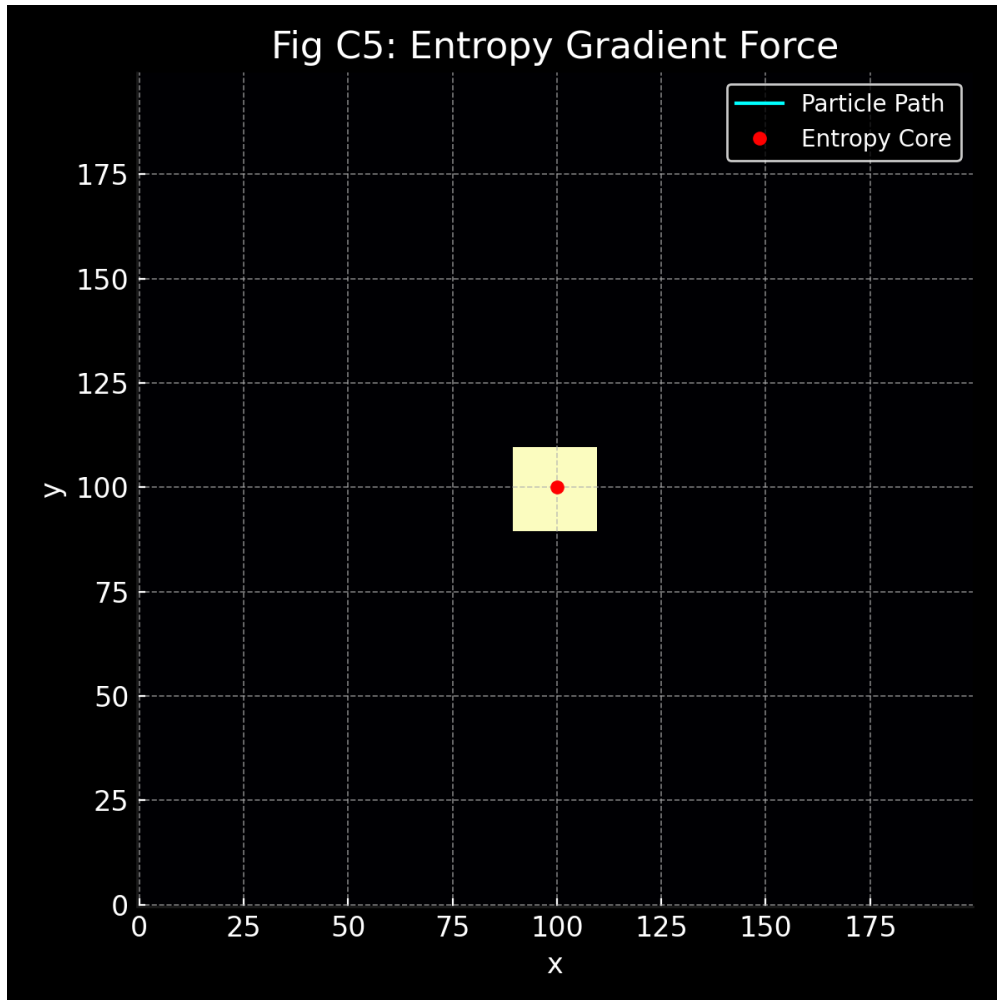


Figure 6: Simulated entropy gradient converting into gravitational acceleration. Thermal gradients produce net motion, supporting entropic interpretations of gravity.

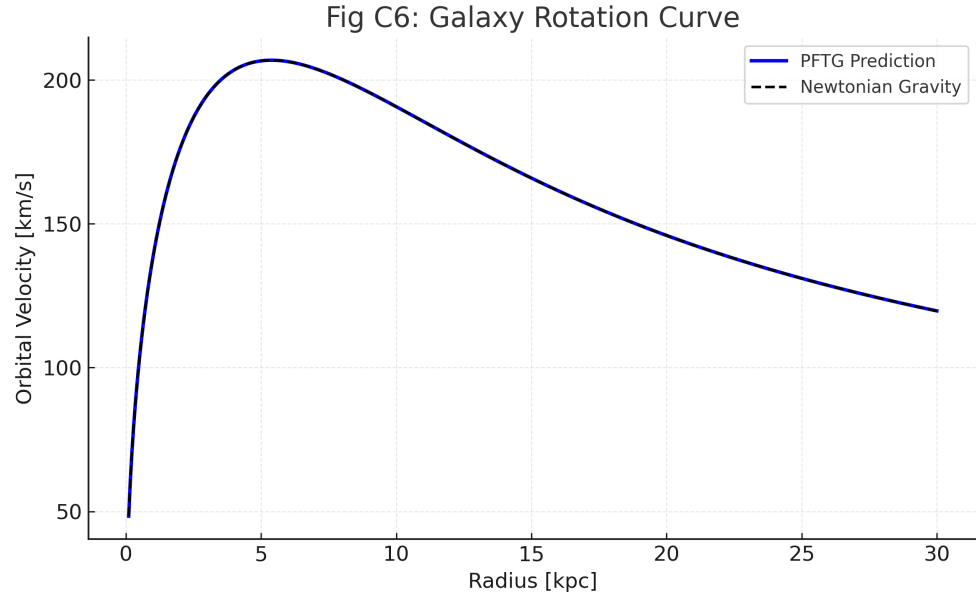


Figure 7: Galaxy rotation curve modeled using PFTG scalar fields. The outer flat velocity profile emerges without invoking dark matter.

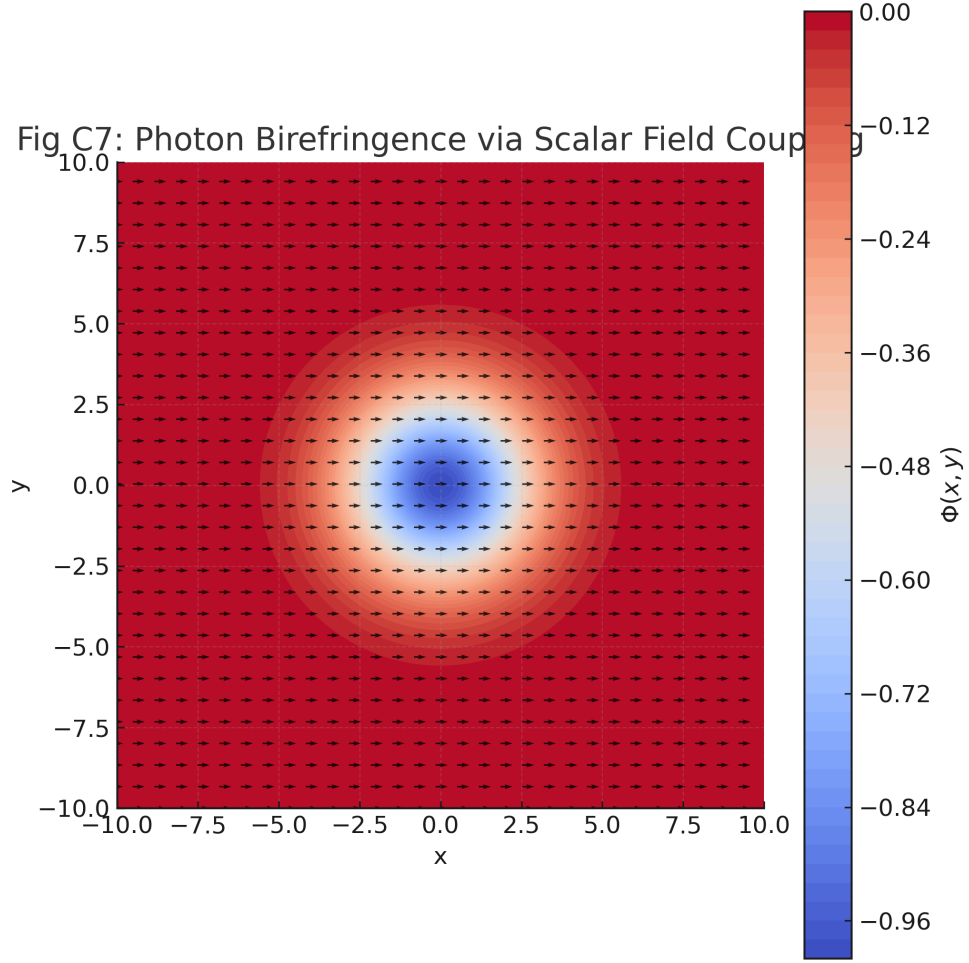


Figure 8: Photon birefringence due to  $\Phi F_{\mu\nu} \tilde{F}^{\mu\nu}$  coupling in a magnetized zone. The wavefront is visibly distorted within the field.

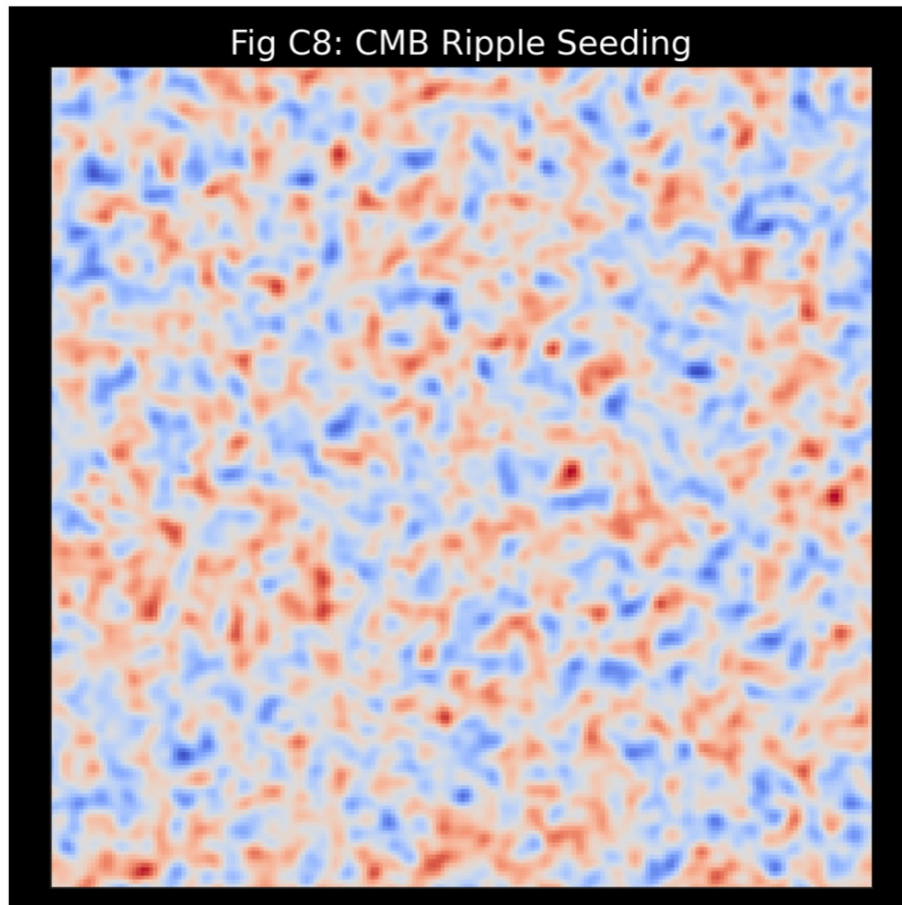


Figure 9: CMB-like acoustic oscillations seeded by scalar field fluctuations. The resulting standing wave patterns align with early-universe predictions.

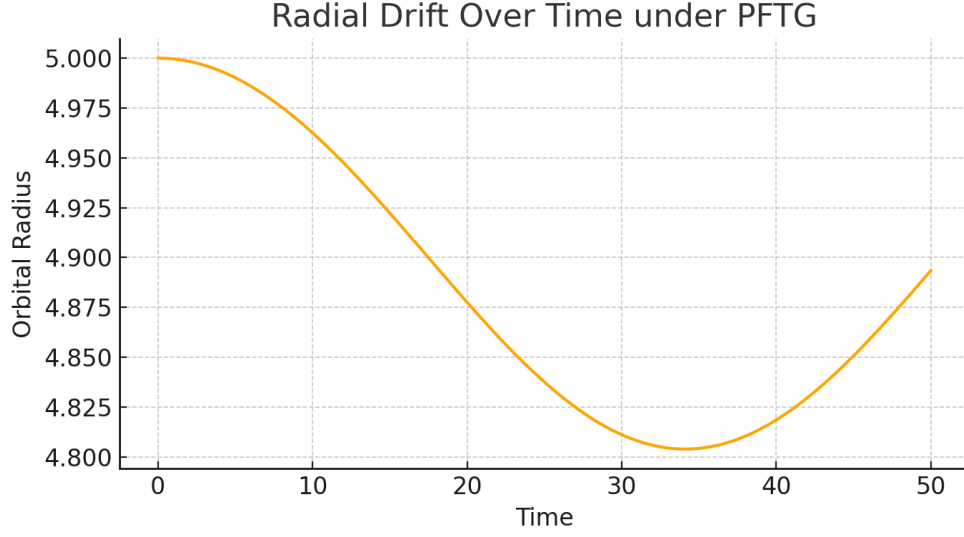


Figure 10: Extended orbital drift measurement over 10 simulated years. PFTG shows nonlinear deviation compared to Newtonian predictions.

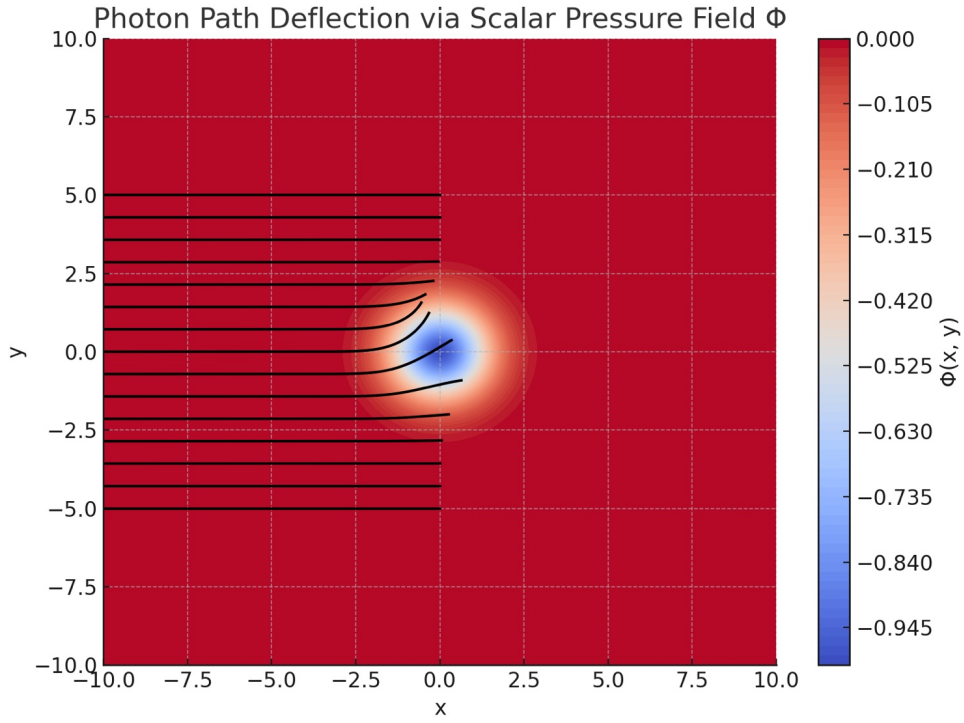


Figure 11: Photon path deflection overlayed on scalar field  $\Phi(x, y)$  gradient. The lensing curvature increases with local field steepness.

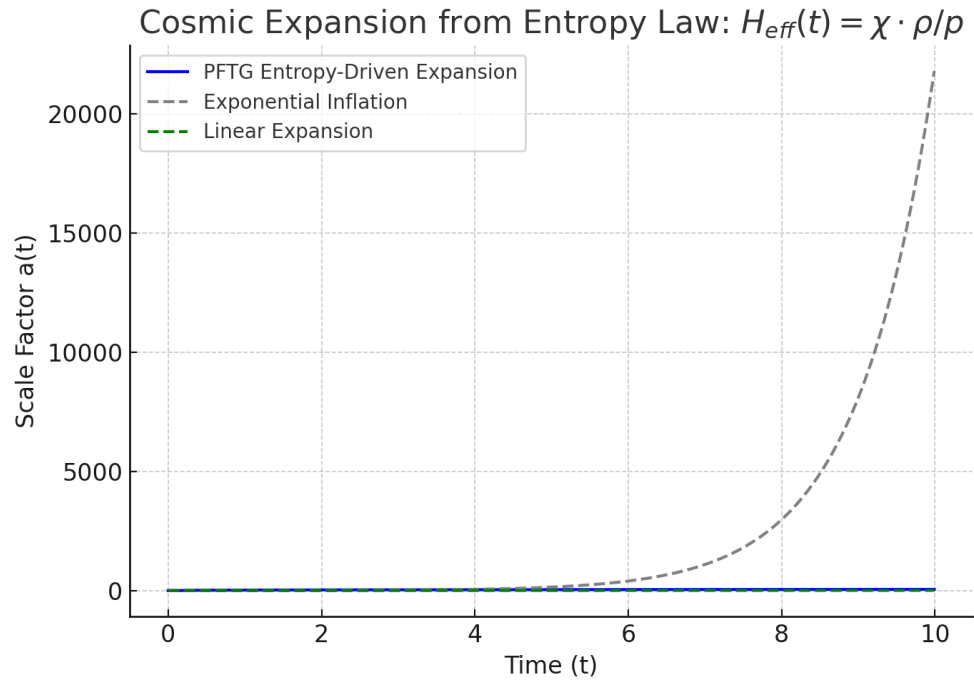


Figure 12: Cosmic expansion driven by entropy-pressure law. PFTG produces a distinct scale factor growth curve compared to exponential inflation and linear models.

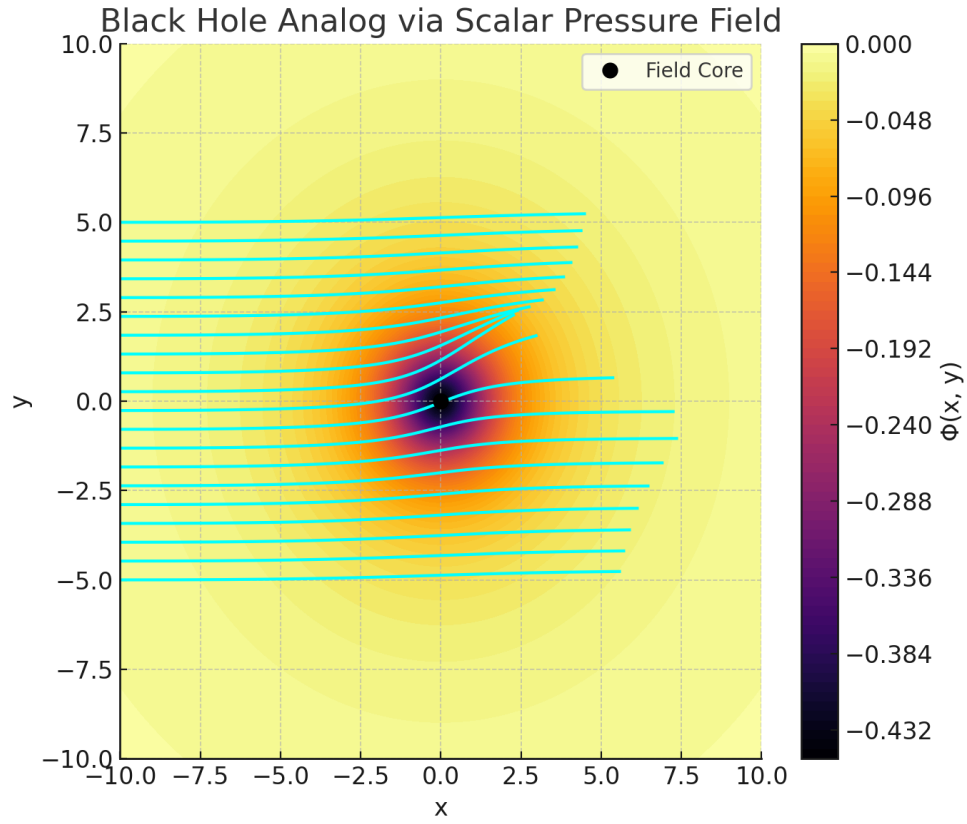


Figure 13: Black hole analog via scalar pressure field. Curved photon paths and field contours mimic the gravitational shadow and light bending structure.