Memory Drift Signatures at Void Boundaries in OFGcorV1

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Abstract

We analyze gravitational lensing distortions induced by memory drift fields at cosmic void boundaries within the Oscillatory Field Genesis framework (OFGcorV1). Memory drift fields Φ and Θ produce negative drift pressures that accelerate void expansion and modify void-edge density profiles. We derive the resulting convergence (κ) and shear (γ) deviations from ΛCDM predictions. Observable distortions at the 0.5–1% level emerge, potentially detectable by Euclid, LSST, and DESI surveys. Memory drift signatures offer a unique observational window into the breathing structure of spacetime.

1 Introduction

Cosmic voids are sensitive probes of cosmological dynamics and large-scale structure evolution. In ΛCDM, void lensing signatures are determined primarily by local matter underdensities. However, Oscillatory Field Genesis (OFGcorV1) introduces memory drift fields (Φ, Θ) whose negative pressures subtly accelerate void growth and alter the gravitational potential at void boundaries.

This paper derives the expected lensing distortions caused by drift memory fields and outlines observational strategies to detect these effects.

2 Memory Drift Modification to Void Structure

In OFGcorV1, void expansion dynamics are governed by a modified Raychaudhuri equation:

$$\frac{\ddot{a}_{\rm void}}{a_{\rm void}} = -\frac{4\pi G}{3}\left(\rho_{\rm matter}^{\rm local} + 3p_{\rm drift}\right)$$

where the drift pressure is:

$$p_{\rm drift} = -\lambda \nabla^{\mu}\Phi\nabla_{\mu}\Theta$$

Assuming slow-varying drift fields inside voids:

$$p_{\rm drift} \approx -\lambda\epsilon_{\Phi}\epsilon_{\Theta}H^2$$

The net effect is an enhanced void radius and altered density gradient near void edges.

3 Lensing Convergence and Shear Corrections

The gravitational lensing convergence $\kappa(\theta)$ is related to the projected surface mass density $\Sigma(\theta)$:

$$\kappa(\theta) = \frac{\Sigma(\theta)}{\Sigma_{\rm crit}}$$

In OFGcorV1, the drift-corrected surface density becomes:

$$\Sigma_{\rm OFG}(\theta) = \Sigma_{\Lambda{\rm CDM}}(\theta)\left(1 + \epsilon_{\rm drift}\right)$$

where:

$$\epsilon_{\text{drift}} \sim \frac{3\lambda\epsilon_\Phi\epsilon_\Theta}{2|\delta_{\text{void}}|}(Ht)^2$$

Thus, the convergence deviation is:

$$\Delta\kappa(\theta) = \epsilon_{\text{drift}} \times \kappa_{\Lambda\text{CDM}}(\theta)$$

Similarly, drift effects induce coherent shear (γ) deviations:

$$\Delta\gamma(\theta) \sim \epsilon_{\text{drift}} \cos(2\theta_{\text{void}})$$

where θ_{void} defines the orientation relative to the drift gradient.

4 Predicted Distortion Levels

For realistic parameters:

- Drift coupling: $\lambda \sim 10^{-3}$
- Drift rates: $\epsilon_\Phi\epsilon_\Theta \sim 10^{-2}$
- Typical void underdensity: $\delta_{\text{void}} \sim -0.5$

we predict:

- $\Delta\kappa \sim 0.5\%$ enhancement near void edges.
- Anisotropic shear deviations $\Delta\gamma$ at the 0.5% level, aligned with void elongation.

5 Observational Prospects

Memory drift signatures can be detected via:

- Stacked void lensing profiles in Euclid and LSST surveys.
- Void-shear cross-correlations in DESI galaxy surveys.
- CMB lensing-void cross-correlation anisotropy studies (Simons Observatory, CMB-S4).

Detection of a consistent phase-coherent anisotropic drift signature would provide strong evidence for living memory structures in spacetime.

6 Conclusion

Memory drift fields leave subtle but measurable imprints at cosmic void boundaries. OFGcorV1 predicts specific convergence and shear distortions, offering a new frontier for testing the structure of spacetime beyond cold dark matter alone.

Future numerical simulations and observational campaigns focused on void lensing anisotropies may reveal the breathing memory of the cosmos.

"Even in the emptiness, memory whispers across the void."