

Addendum: Visual Summary - Harmonic Scale Hierarchy

Date: 23 November 2025
Type: Supplementary Material
Related to: Complete Harmonic Scale Addendum

Quick Reference

Predicted Scales

$\lambda_{12} = 0.538 \pm 0.019 \text{ Mpc}$ $\lambda_{13} = 0.856 \pm 0.030 \text{ Mpc}$ (original pre-registration) $\lambda_{14} = 1.385 \pm 0.048 \text{ Mpc}$

Theoretical Basis

$$\lambda_n = \lambda_2 \times \varphi^{n-2}$$

where:

$\lambda_2 = 4.30 \text{ kpc}$ (measured from SPARC galaxies)

$\varphi = 1.618...$ (golden ratio)

n = harmonic mode index

Scale Ratios

Ratio	Prediction	Physical Meaning
$\lambda_{13} / \lambda_{12}$	$\varphi = 1.618$	Geometric progression
$\lambda_{14} / \lambda_{13}$	$\varphi = 1.618$	Geometric progression

Success Criteria

Tier 1: Single Detection

Detection of any peak within $\pm 10\%$ of predicted values.

Tier 2: Multiple Detection

Detection of two or more peaks within $\pm 10\%$ of predicted values.

Tier 3: Pattern Confirmation

Multiple detections with measured ratios consistent with $\varphi \pm 0.05$.

Falsification Criteria

1. No detectable peaks at predicted scales in Euclid DR1
 2. Peaks detected at locations with >20% deviation
 3. Multiple peaks with ratio deviations >10% from φ
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Observational Context

Euclid Wide Survey

- Optimal sensitivity range: 0.1-10 Mpc
- Target redshift: $z \sim 0.5-1.5$
- Expected precision: sub-percent in $\xi(r)$

Expected vs. Λ CDM

- Λ CDM: smooth power-law decline
 - 3D+3D: discrete peaks at $\lambda_{12}, \lambda_{13}, \lambda_{14}$
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Key Distinctions

Empirical Fit vs. Prediction

Quantity	Type	Data Source
$\lambda_2 = 4.30 \text{ kpc}$	Fit	SPARC galaxies (175)
$\lambda_n \text{ (n>2)}$	Prediction	Theory (no additional fits)

Pattern Recognition

Detection of multiple scales provides stronger support than single scale detection because:

1. Independent tests at each scale
 2. Ratio constraint (φ) adds additional criterion
 3. Geometric origin more clearly distinguished from statistical fluctuations
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Timeline and Integrity

Original Pre-registration:

$\lambda_{13} = 0.856 \text{ Mpc}$ (published before Euclid DR1)

This Addendum:

λ_{12} , λ_{13} , λ_{14} complete hierarchy (23 Nov 2025, before Euclid DR1)

Euclid DR1:

Expected 2026 Q1-Q2 (data not yet available)

Analysis Status:

Euclid Flagship mock (Λ CDM) in progress, results not examined

Theoretical Foundation

The harmonic progression derives from dimensional reduction of 6D spacetime with signature $(-, +, +, +, -, -)$. Two compactified temporal dimensions with radius R generate a discrete hierarchy of characteristic scales related by ϕ due to self-similar geometric structure.

See main addendum document for complete derivation and mathematical details.

Bottom Line

Single prediction: $\lambda_{13} = 0.856$ Mpc

Complete hierarchy: λ_{12} , λ_{13} , λ_{14} with ratio ϕ

Advantage: More falsifiable, pattern recognition, stronger test

Distinction from post-hoc fitting:

- All values derived from single fundamental scale (λ_2)
 - Published before observational data (Euclid DR1)
 - Explicit success/failure criteria
 - Makes theory more constrained, not less
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