

# Pre-Registered Predictions for Euclid DR1 and DESI DR2

## Specific Falsifiable Tests of 3D+3D Theory from Upcoming Surveys

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**Pre-Registration Date:** December 20, 2025 (before Euclid DR1 release)

**Version:** 1.0

**Status:** PRE-REGISTERED PREDICTIONS — LOCKED

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### Abstract

We present specific, quantitative, falsifiable predictions from the 3D+3D discrete spacetime theory for upcoming data releases from the Euclid Space Mission (DR1) and the Dark Energy Spectroscopic Instrument (DESI DR2). These predictions are **pre-registered before data release** to prevent post-hoc parameter adjustment. The theory makes **15 specific predictions** across 5 observational channels. Each prediction includes the central value, uncertainty range, and explicit falsification criterion. The theory will be considered **falsified** if 3 or more independent predictions fail at  $>3\sigma$  significance.

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### 1. The $\phi$ -Ladder Scale Hierarchy

The 3D+3D theory predicts characteristic scales following the golden ratio:

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

where  $\phi = 1.618...$  is the golden ratio.

Key Scales

n	$\lambda_n$ (Mpc)	Physical Association
2	0.0452	Q <sub>2</sub> Compton wavelength
3	0.0286	Q <sub>3</sub> Compton wavelength
9	0.811	Cosmic web scale
13	<b>0.856</b>	Primary detection scale

2. Euclid DR1 Predictions (5 predictions)

E1: Cosmic Shear Power Spectrum

**Prediction:** Enhancement in  $C_{\ell}^{\kappa\kappa}$  at  $\ell = 750 \pm 100$

$$\left. \frac{\Delta C_{\ell}}{C_{\ell}^{\Lambda CDM}} \right|_{\ell=750} = 0.08 \pm 0.02$$

**Falsification:** No enhancement  $> 0.04$  detected

E2: Galaxy-Galaxy Lensing

**Prediction:** Oscillatory deviation from NFW at  $r = 200 \pm 50$  kpc

$$\left. \frac{\Delta \Sigma_{3D3D} - \Delta \Sigma_{NFW}}{\Delta \Sigma_{NFW}} \right|_{r=200\text{kpc}} = -0.12 \pm 0.04$$

**Falsification:** No deviation with amplitude  $> 0.06$

E3: Tomographic Correlations

**Prediction:** Cross-bin correlation at  $\theta = 8 \pm 2$  arcmin

$$\rho_{ij} > 0.7$$

for adjacent redshift bins

**Falsification:**  $\rho_{ij} < 0.5$  for majority of bins

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#### E4: Cluster Lensing Deficit

**Prediction:** 25% deficit at  $M_{\text{crit}} = (1.8 \pm 0.3) \times 10^{11} M_{\odot}$

$$\left. \frac{\gamma_t^{obs} - \gamma_t^{NFW}}{\gamma_t^{NFW}} \right|_{M_{crit}} = -0.25 \pm 0.05$$

**Falsification:** No deficit  $> 0.15$  at any mass  $10^{11}$ - $10^{12} M_{\odot}$

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#### E5: Intrinsic Alignment Modulation

**Prediction:** Scale-dependent oscillation

$$A_{IA}(r) = A_0 [1 + 0.15 \sin(2\pi r / \lambda_{13})]$$

**Falsification:** No oscillation with amplitude  $> 0.08$

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### 3. DESI DR2 Predictions (5 predictions)

#### D1: Correlation Function $\xi(r)$

**Prediction:** Secondary peak at  $r_{13} = 0.856 \pm 0.030$  Mpc

$$\xi(r_{13}) / \xi_{power-law}(r_{13}) = 1.08 \pm 0.02$$

**Falsification:** No excess  $> 1.04$  at  $r = 0.8$ - $0.9$  Mpc

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#### D2: Power Spectrum Feature

**Prediction:** Feature at  $k_{13} = 7.3 \pm 0.3 \text{ Mpc}^{-1}$

$$\frac{P(k_{13}) - P_{smooth}}{P_{smooth}} = 0.05 \pm 0.01$$

**Falsification:** No feature  $> 0.03$  at  $k = 7.0\text{-}7.6 \text{ Mpc}^{-1}$

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**D3: BAO Peak Shift**

**Prediction:**

$$\frac{r_{BAO}^{3D3D}}{r_{BAO}^{\Lambda CDM}} = 1.003 \pm 0.001$$

**Falsification:** Ratio  $< 1.001$  or  $> 1.005$

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**D4: Redshift-Space Distortions**

**Prediction:** Enhancement at  $z > 1$

$$\frac{f\sigma_8^{3D3D}}{f\sigma_8^{\Lambda CDM}} \Big|_{z=1.5} = 1.02 \pm 0.01$$

**Falsification:** Ratio  $< 1.00$  at  $z > 1$

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**D5: Void Statistics**

**Prediction:** Peak void size  $R = 12 \pm 2 \text{ Mpc}$

**Falsification:** Peak outside range 8-16 Mpc

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**4. Cross-Survey Predictions (5 predictions)**

**X1: Euclid  $\times$  DESI Cross-Correlation**

**Prediction:**

$$C_{\ell}^{\kappa g} \Big|_{\ell=750} = (2.5 \pm 0.5) \times 10^{-5}$$

**Falsification:** No detection with  $S/N > 3$  at  $\ell = 600\text{-}900$

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**X2:  $\phi$  Ratio Consistency**

**Prediction:**

$$\frac{\lambda_9}{\lambda_8} = \phi = 1.618 \pm 0.05$$

from both surveys independently

**Falsification:** Ratio differs between surveys by  $> 10\%$

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**X3: Redshift Evolution**

**Prediction:** Comoving  $\lambda_{13} = 0.856$  Mpc is constant

**Falsification:** Evolution  $|d\lambda_{13}/dz| > 0.1$  Mpc per unit  $z$

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**X4: Mass-Dependent Deficit**

**Prediction:** V-shaped profile centered at  $M_{\text{crit}}$  with  $\sigma_M = 0.3$  dex

**Falsification:** Deficit not peaked at  $M = (1-3) \times 10^{11} M_\odot$

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**X5: Temporal Stability**

**Prediction:** No time variation in clustering or lensing

**Falsification:** Any significant ( $>3\sigma$ ) time variation

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**5. Summary Table**

ID	Observable	Predicted Value	$\sigma$	Falsification Threshold
E1	C_ℓ enhancement	+8%	±2%	<4%
E2	ΔΣ deviation	−12%	±4%	>−6%
E3	Bin correlation	>0.7	—	<0.5
E4	Cluster deficit	−25%	±5%	>−15%

ID	Observable	Predicted Value	$\sigma$	Falsification Threshold
E5	IA oscillation	15% amp	$\pm 7\%$	$< 8\%$
D1	$\xi(r)$ excess	+8%	$\pm 2\%$	$< 4\%$
D2	P(k) feature	+5%	$\pm 1\%$	$< 3\%$
D3	BAO shift	$\times 1.003$	$\pm 0.001$	Outside [1.001,1.005]
D4	$f\sigma_8$ ratio	$\times 1.02$	$\pm 0.01$	$< 1.00$
D5	Void peak	12 Mpc	$\pm 2$ Mpc	$< 8$ or $> 16$ Mpc
X1	Cross-corr	$2.5 \times 10^{-5}$	$\pm 0.5 \times 10^{-5}$	No $3\sigma$ detection
X2	$\varphi$ consistency	1.618	$\pm 0.05$	$> 10\%$ discrepancy
X3	z-evolution	Constant	—	
X4	M-dependence	Peak at $M_{\text{crit}}$	$\pm 0.3$ dex	Wrong peak
X5	Time stability	Zero	—	Any $3\sigma$ variation

6. Falsification Protocol

Theory is FALSIFIED if:

3 or more predictions fail at  $> 3\sigma$

Theory is STRONGLY SUPPORTED if:

- 10+ predictions confirmed at  $> 2\sigma$
- No predictions fail at  $> 3\sigma$
- Combined significance  $> 5\sigma$

7. Verification Code

```
python
```

```
"""
```

Verification code for 3D+3D predictions

Run after Euclid/DESI data release

```
"""
```

```
import numpy as np
```

```
from scipy import stats
```

```
PREDICTIONS = {
```

```
    'E1': {'value': 0.08, 'sigma': 0.02, 'fail_below': 0.04},
```

```
    'E2': {'value': -0.12, 'sigma': 0.04, 'fail_above': -0.06},
```

```
    'E3': {'value': 0.7, 'sigma': 0.1, 'fail_below': 0.5},
```

```
    'E4': {'value': -0.25, 'sigma': 0.05, 'fail_above': -0.15},
```

```
    'E5': {'value': 0.15, 'sigma': 0.07, 'fail_below': 0.08},
```

```
    'D1': {'value': 1.08, 'sigma': 0.02, 'fail_below': 1.04},
```

```
    'D2': {'value': 0.05, 'sigma': 0.01, 'fail_below': 0.03},
```

```
    'D3': {'value': 1.003, 'sigma': 0.001, 'fail_range': [1.001, 1.005]},
```

```
    'D4': {'value': 1.02, 'sigma': 0.01, 'fail_below': 1.00},
```

```
    'D5': {'value': 12, 'sigma': 2, 'fail_range': [8, 16]},
```

```
}
```

```
def check_prediction(pred_id, observed, obs_sigma):
```

```
    pred = PREDICTIONS[pred_id]
```

```
    total_sigma = np.sqrt(pred['sigma']**2 + obs_sigma**2)
```

```
    deviation = abs(observed - pred['value']) / total_sigma
```

```
    if 'fail_below' in pred:
```

```
        failed = observed < pred['fail_below']
```

```
    elif 'fail_above' in pred:
```

```
        failed = observed > pred['fail_above']
```

```
    else:
```

```
        lo, hi = pred['fail_range']
```

```
        failed = observed < lo or observed > hi
```

```
    return {'deviation_sigma': deviation, 'failed': failed}
```

```
def evaluate_theory(results):
```

```
    n_failed = sum(1 for r in results.values() if r['failed'])
```

```
    status = 'FALSIFIED' if n_failed >= 3 else 'SUPPORTED'
```

```
    return {'n_failed': n_failed, 'status': status}
```

8. Timeline

Date	Event
Dec 20, 2025	Pre-registration locked
Q1 2025	Euclid DR1 release
Late 2025	DESI DR2 release
2026	Full verification report

CERTIFICATION

These predictions are locked as of **December 20, 2025**.

No modifications to central values or uncertainties after data release.

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15 PREDICTIONS PRE-REGISTERED AND LOCKED

**Document Status:** PRE-REGISTERED

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**December 2025**