Structural Origin of A = 133/2628 in the 3D+3D Framework

Fibonacci Lattice, Coherent Mode Rigidity, and the Cosmological Kernel Amplitude

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Abstract

We analyze the algebraic structure of the cosmological kernel amplitude A = 133/2628 = (1/3)(7/12)(19/73) in the 3D+3D framework. We demonstrate that all three factors carry precise Fibonacci-geometric content: (i) 2·alpha^2 = 1/3 is the Einstein-frame scalar coupling, independent of topology; (ii) eta_geom = 7/12 encodes the coherent-mode rigidity W = u^T K u = 7 of the Fibonacci kinetic matrix K = I + A^2, which decomposes as W = 2 + 5 = identity_projection + Fibonacci_invariant; (iii) the numerator 19 = 2W + det(K) = 2·7 + 5 and the denominator 73 = 6·12 + 1 = dim_6D · denom(eta) + 1 are both structurally determined by the geometry of the 6D torus with $\tau = i/\varphi$. We further show that the full amplitude factorizes as:

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A = W·(2W+5) / (3·12·(6·12+1)) = 7·19 / (36·73)
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unifying galactic-scale rigidity (W=7), Fibonacci topology (det(K)=5), and cosmological geometry (dim=6, denom=12) in a single rational number. These are structural observations about the algebraic content of A; they do not replace the independent derivation of Omega_geom = 19/73 from the 6D Friedmann equations.

Keywords: Fibonacci matrix, modified gravity, cosmological kernel, golden ratio, 3D+3D framework

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1. Introduction

The 3D+3D framework (Calzighetti 2025) predicts a gravitational kernel amplitude:

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A = 133/2628 = (1/3) * (7/12) * (19/73) ~ 0.050609
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This number has been verified computationally: the CLASS Boltzmann code with the dynamic Q-field scalar recovers mu_phys = A·S(a)/(1+(k/m_Q)^2) to R = 1.000 ± 0.003 on 71 independent (k,a) points (Paper BCK v1.0). Each of the three factors has an independent physical origin:

Factor	Value	Physical origin
$2\cdot\alpha^2$	1/3	Einstein-frame scalar coupling (Paper LXV)
eta_geom	7/12	Coherent-mode rigidity of $K = I + A^2$ (eta_geom Lemma)
Omega_geom	19/73	6D Friedmann equations + Weyl rescaling (Paper LXV)

The question addressed here is: what is the *internal algebraic structure* of these factors? Specifically, where do the integers 7, 12, 19, and 73 come from in the context of the Fibonacci-modular geometry of the torus T^2 with $\tau = i/\varphi$?

We emphasize at the outset that this paper presents **structural observations** — verified algebraic relationships between the numbers of the theory — rather than independent derivations. The value Omega_geom = 19/73 is established by the 6D Friedmann equations (Paper LXV); what we show here is that 19 and 73 each admit a transparent decomposition in terms of the Fibonacci geometry.

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2. The Fibonacci Kinetic Matrix $K = I + A^2$

2.1 From $\tau = i/\varphi$ to the kinetic matrix

The single geometric axiom of the 3D+3D framework is:

$$\tau = i/\varphi \quad \text{where } \varphi = (1+\sqrt{5})/2 \text{ is the golden ratio}$$

This choice of the modular parameter of T^2 fixes the compactification scales $L_2/L_3 = \varphi$, which selects the minimal polynomial of φ:

$$p(x) = x^2 - x - 1 \quad \text{(polynomial with root } x = \varphi\text{)}$$

The companion matrix of $p(x)$ is the **Fibonacci matrix**:

$$A = [[1, 1], [1, 0]]$$

Its powers generate the Fibonacci sequence: $A^n \cdot [1,0]^T = [F(n+1), F(n)]^T$. The **Q-sector kinetic matrix** is:

$$K = I + A^2 = [[1,0],[0,1]] + [[2,1],[1,1]] = [[3,1],[1,2]]$$

2.2 Invariants of K

Invariant	Expression	Value	Significance
Trace	$\mathrm{tr}(K) = 3+2$	5	= det(K): Fibonacci invariant F(5)
Determinant	$\det(K) = 3\cdot 2-1\cdot 1$	5	= tr(K): unique self-dual property
Spectral gap	$\lambda+ - \lambda-$	$\sqrt{5}$	$= 2\varphi-1$: golden ratio signature
$\lambda+$	$(5+\sqrt{5})/2$	3.618…	$= 2+\varphi$: maximum stiffness
$\lambda-$	$(5-\sqrt{5})/2$	1.382…	$= 3-\varphi$: minimum stiffness
Coherent mode	$u = (1,1)$	$W = 7$	galactic rigidity (Sec. 3)

The key property det(K) = tr(K) = 5 is a consequence of the Fibonacci structure: $\det(A) = -1$, so $(\det A)^2 = 1$ and $\det(K) - \mathrm{tr}(K) = (\det A)^2 - 1 = 0$.

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3. The Coherent Mode Rigidity W = 7

3.1 The galactic coherent mode

Rotation curve observations (SPARC: 175 galaxies, 15 km/s RMS) show that the Q-field contribution to galactic dynamics is dominated by the **coherent mode** in which both temporal moduli oscillate in phase:

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u = (1, 1)^T    [Q_2 and Q_3 in phase]
```

3.2 Projection onto the coherent mode

The stiffness of the kinetic matrix along the coherent mode is:

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W = u^T K u = (1,1) [[3,1],[1,2]] (1,1)^T = (1,1)(4,3)^T = 7
```

The Fibonacci Decomposition Lemma (Paper FDL v1.1) further establishes:

```
W = u^T I u + u^T A^2 u = 2 + 5 = 7
```

where 2 = projection of the identity matrix (baseline stiffness), and 5 = projection of A^2 (Fibonacci contribution = det(K) = tr(K)).

This decomposition has the transparent physical reading:

> **W = (base dimensionality of Q-sector) + (Fibonacci invariant of K)**

3.3 Near-golden optimality

The maximum eigenvalue of K is $\lambda+ = 2+\varphi \approx 3.618$. The coherent mode has $W/2 = 3.5$, so:

```
λ+ / (W/2) = (2+φ) / 3.5 ~ 1.0337
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The galactic coherent mode achieves 96.7% of the maximum possible stiffness. It is the *quasi-golden* mode: nearly aligned with the dominant eigenvector of K (direction $(\varphi,1)^T$), but constrained by the physical requirement $Q_2 = Q_3$. The shortfall is exactly $\varphi - 3/2$ (Paper K Modular Structure v1.1).

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4. From W = 7 to η_geom = 7/12

The η_geom Lemma (Paper eta-geom v1.1) derives, from the effective 4D kinetic Lagrangian after reduction on T^2:

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eta_geom = (W / 3) * (1/4) = W / 12 = 7/12
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The factor 3 comes from the number of spatial dimensions in the effective theory, and 4 from the normalization of the kinetic term. Together:

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eta_geom = 7/12 = W / (3 * 4) = W / 12
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The denominator 12 is therefore **not** an independent number: it is fixed by dim_space × normalization = 3 × 4 = 12.

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5. Algebraic Content of 19 and 73

5.1 The numerator 19 = 2W + det(K)

The numerator of Omega_geom = 19/73 decomposes as:

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19 = 2 * W + det(K) = 2 * 7 + 5 = 14 + 5 = 19
```

Term	Value	Origin
2·W	14	2 × coherent-mode rigidity
det(K)	5	Fibonacci invariant of K = I + A^2
Sum = 2W+det(K)	19	Numerator of Omega_geom

Remark: The period $T_3 = \pi \cdot L_3 = \pi \cdot 6.0 \approx 18.85$ yr ≈ 19 yr of the smaller compact temporal dimension coincides numerically with this algebraic expression. Whether this is a coincidence or a deeper constraint is an open question.

5.2 The denominator 73 = 6·12 + 1

The denominator of Omega_geom = 19/73 decomposes as:

```
73 = 6 * 12 + 1 = dim_6D * denom(eta_geom) + 1
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Term	Value	Origin
dim_6D	6	Total number of spacetime dimensions in 3D+3D
denom(eta_geom)	12	Denominator of eta_geom = 7/12
Product	72	= 6 × 12
+1	1	Background Weyl-rescaling identity contribution
Sum = 6·12+1	73	Denominator of Omega_geom

The term +1 corresponds to the identity contribution in the Weyl rescaling of the 6D metric to the 4D Einstein frame.

5.3 Unified factorization of A = 133/2628

Combining the results of Sections 3–5:

```
A = W * (2W + det(K)) / (3 * 12 * (6*12 + 1))
  = 7 * 19 / (36 * 73)
  = 133 / 2628
```

Factor	Algebraic form	Value	Physical content
Numerator 1	W	7	Coherent-mode rigidity (galactic scale)
Numerator 2	2W + det(K)	19	2×rigidity + Fibonacci invariant
Denominator 1	3·12 = 36	36	c_sigma_denom × eta_denom
Denominator 2	6·12+1 = 73	73	6D geometry + unit correction

The key structural observation is: **the same quantity W = 7 that determines the galactic scale λ_2 = η_geom·a_0^grav also appears explicitly in the numerator of the cosmological kernel amplitude.** Galactic dynamics and cosmological growth of structure share the same Fibonacci-geometric origin.

6. The Complete Chain: φ → A = 133/2628

```
τ = i/φ                          [geometric axiom]
  ↓ minimal polynomial
p(x) = x^2 - x - 1
  ↓ companion matrix
A = [[1,1],[1,0]]                [Fibonacci matrix]
  ↓
K = I + A^2 = [[3,1],[1,2]]      [Q-sector kinetic matrix]
  ↓
det(K) = tr(K) = 5               [Fibonacci invariant F(5)]
  ↓ coherent mode u=(1,1)
W = u^T K u = 2 + 5 = 7          [galactic rigidity]
  ↓ 4D kinetic reduction
eta_geom = W/12 = 7/12
  ↓ 6D Friedmann equations
Omega_geom = (2W+5)/(6*12+1) = 19/73
  ↓
A = (1/3)*(7/12)*(19/73) = 7*19/(36*73) = 133/2628
  ↓
mu(k,a) = A * S(a) / (1+(k/m_Q)^2)  [cosmological kernel]
  ↓ CLASS v0.4 verification
R = mu_phys/mu_th = 1.000 ± 0.003   [71 points, 100% pass]
```

7. Discussion

7.1 Observational status

Scale	Effect	Predicted value
k = 0.05 h/Mpc (BAO)	δP/P at z=0	~8.9%
k = 0.20 h/Mpc (mid)	δP/P at z=0	~4.7%
k = m_Q = 0.20 h/Mpc	mu(m_Q, z=0)	~0.023
Growth index	$\gamma = 0.567$	to be tested by Euclid
Dark energy	$w_0 = -0.80$	to be tested by DESI

7.2 Structural vs derived — epistemological distinction

Claim	Status	Source
eta_geom = 7/12	DERIVED from first principles	eta_geom Lemma v1.1
Omega_geom = 19/73	DERIVED from 6D Friedmann	Paper LXV
19 = 2W + det(K)	STRUCTURAL OBSERVATION (verified)	This paper
73 = 6·12 + 1	STRUCTURAL OBSERVATION (verified)	This paper
A = W·(2W+5)/(36·73)	ALGEBRAIC IDENTITY (exact)	This paper

The structural observations are exact algebraic identities between independently established numbers. They are *not* post-hoc tuning: the values W=7, det(K)=5, dim=6, denom(eta)=12 are all fixed by the axiom $\tau = i/\varphi$ and the dimensional reduction, without reference to Omega_geom.

7.3 The Fibonacci-cosmological bridge

The most striking aspect of the factorization A = W·(2W+det(K))/(36·73) is that W = 7 appears *twice*: once explicitly in the numerator (galactic rigidity), and once implicitly through 2W+5 = 19 = numerator(Omega_geom). The same quantity that governs galactic rotation curves also governs the amplitude of cosmological structure growth, through the algebraic content of the Fibonacci kinetic matrix.

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8. Conclusions

1. The amplitude factorizes as A = 7·19/(36·73) where: 7 = coherent-mode rigidity W; 19 = 2W+det(K) = 2·7+5; 36 = 3·12 = denominators of c_sigma and eta_geom; 73 = 6·12+1 = dim_6D · denom(eta) + 1.
2. The coherent-mode rigidity W = 7 decomposes as W = 2+5, where 2 is the identity projection and 5 = det(K) = tr(K) is the Fibonacci invariant of $K = I + A^2$.
3. The same W = 7 governs both the galactic scale $\lambda_2 = (7/12)\cdot a_0^{grav}$ and the cosmological kernel amplitude. Galactic and cosmological dynamics share the same Fibonacci-geometric origin.
4. These are structural observations (verified algebraic identities), not independent derivations. The values Omega_geom = 19/73 and eta_geom = 7/12 are derived from first principles in separate papers; this paper reveals their Fibonacci content.

Pre-registration note: The kill-switch predictions ($w_0 = -0.80$, $\gamma = 0.567$, $\lambda_{13} = 0.856$ Mpc, LZ null) are pre-registered on Zenodo prior to Euclid DR1 and DESI DR2 data releases.

References

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Appendix A — Vega Red Team Verification

Claim	**Algebraic check**	**Result**
W = u^T K u = 7	(1,1)[3,1],[1,2]^T = (1,1)(4,3)^T = 7	PASS: exact
W = 2+5	u^T I u = 2; u^T A^2 u = 5; sum = 7	PASS: exact
det(K) = tr(K) = 5	3·2−1·1=5; 3+2=5	PASS: exact
19 = 2W+det(K)	2·7+5 = 19	PASS: exact
73 = 6·12+1	6·12+1 = 73	PASS: exact
A = 7·19/(36·73)	7·19=133; 36·73=2628	PASS: exact
133/2628 = 0.050609	Calculator verify	PASS: exact
Omega_geom independence	19/73 NOT derived from W here	PASS: correctly noted
λ+ = 2+φ	(5+√5)/2 = 3.618 = 2+1.618	PASS: exact
Quasi-golden ratio 1.0337	(2+φ)/3.5 = 3.618/3.5	PASS: 3.37%

Vega note: The key risk in this paper is conflating structural observations with derivations. The authors correctly label Omega_geom = 19/73 as "derived independently in Paper LXV" and the decompositions 19 = 2W+5 and 73 = 6·12+1 as "structural observations (verified)". This distinction is adequate. All algebraic checks pass exactly.