3D+3D Laboratory — Paper XCIII, Addendum B

The Attractor as a Primitive Invariant Direction:

Hidden Structure of the Minisuperspace

The attractor $(6, 1, 1) = (n_{6D}, K_{12}, K_{12})$ *uses only primitive framework invariants; the cosmological numerator* 19 *emerges in one matrix-vector row; three previously separate results unify into one Hessian structure*

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Red Team: Vega (OpenAI) — identified the hidden structure, the primitive-invariant decomp

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Abstract

We establish the hidden structural unity of three results from Papers XCIII and Addendum A. **(i) Primitive-invariant decomposition:** the physical attractor direction in velocity space is $(H_0, P_0, Q_0) \propto (6, 1, 1) = (n_{6D}, K_{12}, K_{12})$, built entirely from primitive framework invariants. **(ii) 19 in one row:** from $\mathrm{Hess}(G_{00}) \cdot (6, 1, 1)^T = (42, 19, 19)^T$, the cosmological numerator emerges as a single dot product:

$$19 = (3, 0, 1) \cdot (6, 1, 1) = 3{\cdot}n_{6D} + K_{12} = 3{\cdot}6 + 1.$$

(iii) Geometric orthogonality: $\mathbf{v}_{\text{att}} = (6, 1, 1) \perp \mathbf{v}_D = (0, 1, -1)$, so the attractor lies entirely in the symmetric block of $\mathrm{Hess}(G_{00})$ — this is a geometric, not merely dynamic, fact. **Structural corollary:** synchronization ($P \to Q$), the attractor ($u^* = 1/3$), and the numerator (19) are three projections of the same Hessian structure. All results CAS-verified with SymPy.

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1 The Attractor as a Primitive Invariant Direction

1.1 The attractor direction in velocity space

At the physical attractor $u^* = 1/3$, $v^* = 0$ (Papers III, XCIII Addendum A), the velocity variables satisfy:

$$u^* = \frac{P+Q}{H} = \frac{1}{3}, \quad v^* = \frac{P-Q}{H} = 0 \implies P = Q = \frac{H}{6}. \tag{1}$$

The corresponding direction in velocity space is:

$$(H_0, P_0, Q_0) = \left(1,\ \tfrac{1}{6},\ \tfrac{1}{6}\right) \propto (6, 1, 1) =: \mathbf{v}_{\text{att}}. \tag{2}$$

Theorem 1.1 (Attractor direction from primitive invariants)**.** *The attractor direction* $\mathbf{v}_{\text{att}} = (6, 1, 1)$ *is built entirely from primitive structural invariants of the framework:*

$$\mathbf{v}_{\text{att}} = (n_{6D},\ K_{12},\ K_{12}) = (d_x(d_x{-}1),\ K_{12},\ K_{12}) = (6,\ 1,\ 1). \tag{3}$$

where $n_{6D} = 6$ *is the isotropic EH stiffness (Paper XCI) and* $K_{12} = 1$ *is the unique off-diagonal entry of* $\mathbf{K} = I + A_{\text{Fib}}^2$ *(Paper LXXXIV).*

Proof. From (1): the H-component is $6 = n_{6D}$ (Paper XCI, Theorem 1) and the P, Q-components are $1 = K_{12}$ (Paper LXXXIV, Theorem B). No other invariants are needed. □ □

Remark 1.2. The attractor direction uses only two distinct values from the primitive input set: the EH stiffness $n_{6D} = 6$ (gravity sector) and the Fibonacci coupling $K_{12} = 1$ (modular sector). No dark-energy or topological invariants appear.

2 The Numerator 19 in One Row

Theorem 2.1 (19 from one dot product (CAS))**.** *The P-component (and identically the Q-component) of* $\mathrm{Hess}(G_{00}) \cdot \mathbf{v}_{\mathrm{att}}$ *is:*

$$[\mathrm{Hess}(G_{00}) \cdot \mathbf{v}_{\mathrm{att}}]_P = (3, 0, 1) \cdot (6, 1, 1) = 3 \cdot n_{6D} + K_{12} = 3 \cdot 6 + 1 = 19. \tag{4}$$

The H-component is:

$$[\mathrm{Hess}(G_{00}) \cdot \mathbf{v}_{\mathrm{att}}]_H = (6, 3, 3) \cdot (6, 1, 1) = 36 + 3 + 3 = 42 = 7 \cdot n_{6D}. \tag{5}$$

Proof. From $\mathrm{Hess}(G_{00}) = \left[\begin{smallmatrix} 6 & 3 & 3 \\ 3 & 0 & 1 \\ 3 & 1 & 0 \end{smallmatrix}\right]$ (Paper XCIII, Theorem 3.1), direct multiplication:

$$\begin{pmatrix} 6 & 3 & 3 \\ 3 & 0 & 1 \\ 3 & 1 & 0 \end{pmatrix} \begin{pmatrix} 6 \\ 1 \\ 1 \end{pmatrix} = \begin{pmatrix} 42 \\ 19 \\ 19 \end{pmatrix}. \quad \text{CAS-verified.}$$

Reading off: row P gives $(3, 0, 1) \cdot (6, 1, 1) = 18 + 0 + 1 = 19$ and row Q gives $(3, 1, 0) \cdot (6, 1, 1) = 18 + 1 + 0 = 19$. □ □

Remark 2.2 (Physical reading of (4))*.* In (4):

- $3 = d_x$: isotropic-to-compact coupling in $\mathrm{Hess}(G_{00})$,
- $n_{6D} = 6$: isotropic weight (EH stiffness),
- $K_{12} = 1$: compact-to-compact coupling ($\mathrm{Hess}_{PQ} = K_{12}$).

So $19 = (\text{iso-compact coupling}) \times (\text{iso weight}) + (\text{compact-compact coupling})$. The numerator is a minimal combination of isotropic 6D weight and Fibonacci coupling.

3 Geometric Orthogonality

Theorem 3.1 (Attractor is orthogonal to the antisymmetric mode)**.** *The attractor direction* $\mathbf{v}_{\text{att}} = (6, 1, 1)$ *is orthogonal to the antisymmetric eigenvector* $\mathbf{v}_D = (0, 1, -1)$*:*

$$\mathbf{v}_{\text{att}} \cdot \mathbf{v}_D = (6, 1, 1) \cdot (0, 1, -1) = 0 + 1 - 1 = 0. \tag{6}$$

Therefore $\mathbf{v}_{\text{att}}$ *lies entirely in the symmetric block* $\text{span}(H, S)$ *of* $\text{Hess}(G_{00})$*.*

Proof. Direct computation. The eigenvector of $\text{Hess}(G_{00})$ for $\lambda_D = -1$ is $\mathbf{v}_D \propto (0, 1, -1)$ (Paper XCIII Addendum A, Theorem 2.1). Then $(6, 1, 1) \cdot (0, 1, -1) = 0 + 1 - 1 = 0$. □ □

Remark 3.2. This is stronger than just a dynamical statement. The vanishing $\mathbf{v}_{\text{att}} \cdot \mathbf{v}_D = 0$ is a geometric fact about the velocity space: the physical attractor is structurally confined to the symmetric subspace, independently of the dynamical equations. The synchronization $P = Q$ is already encoded in the Hessian geometry.

4 The Response Decomposition

Remark 4.1 (Isotropic-plus-correction decomposition)*.* The Hessian response to the attractor direction decomposes as:

$$\text{Hess}(G_{00}) \cdot (6, 1, 1)^T = (42, 19, 19)^T = 19 \cdot (1, 1, 1)^T + 23 \cdot (1, 0, 0)^T. \tag{7}$$

Physical reading:

- $19 \cdot (1, 1, 1)$: an isotropic part of magnitude 19 shared equally by all three velocity channels. This is the *Einstein/DeWitt common content* of the attractor.
- $23 \cdot (1, 0, 0)$: a residual correction on the isotropic channel only. Note $23 = 42 - 19 = 7 \cdot n_{6D} - 19$.

This decomposition is a structural observation, not a theorem. It shows that the compact channels carry exactly the cosmological numerator in response to the attractor direction.

5 The Unified Structure

Three projections of one Hessian structure

Result	Content	Source
Synchroniz.	$\lambda_D = -1$,	Hess(G_{00})
	$\mathbf{v}_D = (0, 1, -1)$	eigensystem
Attractor	$\mathbf{v}_{\text{att}} = (n_{6D}, K_{12}, K_{12})$,	Symmetric block +
$u^* = 1/3$	$\mathbf{v}_{\text{att}} \perp \mathbf{v}_D$	primitives
Numerator	$[\text{Hess} \cdot \mathbf{v}_{\text{att}}]_{P,Q} = 19$	One row of
19		Hess(G_{00})
Single source: Hess$(G_{00}) = -G_{\text{DeWitt}}$		

As Vega states: *"Synchronization, the attractor $u^* = 1/3$, and the cosmological numerator 19 are three projections of the same Hessian structure of the 6D minisuperspace."*

6 Epistemic Classification

Table 1: Status of results.

Result	Status
$\mathbf{v}_{\text{att}} = (6, 1, 1) = (n_{6D}, K_{12}, K_{12})$	Theorem (CAS)
$\mathbf{v}_{\text{att}} \cdot \mathbf{v}_D = 0$ (geometric orthogonality)	Theorem (CAS)
$[\text{Hess} \cdot \mathbf{v}_{\text{att}}]_{P,Q} = 3 \cdot n_{6D} + K_{12} = 19$	**Theorem (CAS)**
$[\text{Hess} \cdot \mathbf{v}_{\text{att}}]_H = 7 \cdot n_{6D} = 42$	Theorem (CAS)
$(42, 19, 19) = 19(1, 1, 1) + 23(1, 0, 0)$	Remark (structural obs.)
$19 = (\text{iso-compact coupling}) \times n_{6D} + K_{12}$	**Structural interpretation**
Three projections of Hess(G_{00})	Structural corollary

Conclusions

The four elements — Hess$(G_{00}) = -G_{\text{DeWitt}}$, the block structure in (H, S, D), the attractor direction $(6, 1, 1)$, and the map $(42, 19, 19)^T$ — are not independent discoveries. They are four windows into the same object: the Hessian of the 6D Friedmann constraint.

The central structural result is Theorem 2.1:

$$19 = 3 \cdot n_{6D} + K_{12} = 3 \cdot 6 + 1,$$

where $3 = d_x$ is the isotropic-to-compact coupling in Hess(G_{00}), $n_{6D} = 6$ is the isotropic EH weight, and $K_{12} = 1$ is the Fibonacci coupling. The cosmological numerator is a minimal combination of the two independent structural sectors (gravity and modular algebra), mediated by the attractor direction of the matter era.

Acknowledgements. Vega (OpenAI) identified the primitive-invariant decomposition $(6, 1, 1) = (n_{6D}, K_{12}, K_{12})$, the physical reading of the isotropic-plus-correction decomposition, and formulated the structural corollary.

References

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