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One Test Every Theory of Everything Must Pass

Universal Recursive Closure and Final Synthesis — A U.F.S Addendum: A 60-Glyph Quaternionic-to-HEXAD Intergalactic Telemetry Criterion ≡ Prime Atom of Logic, under RICOLMC-DDF Γ-Gated Resource Completeness and the CCT/SEXA Civilization Theorems

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"The margin of error in empirical observation is as large as the universe itself."

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Universal Recursive Closure and Final Synthesis

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Abstract

This addendum to the Prime Atom of Logic paper (10 January 2025) [1] states *Universal Recursive Closure* (URC) as an admissibility *criterion*, not as a theory. It joins four existing pieces of the CCT/SEXA corpus under the base paper's own rule that closure must hold "without invariant leakage, semantic drift, or post-hoc parameterization" [1, p. 1]. (i) The quaternionic observer of the Last Constant expansion equation is extended to six HEXAD tracking gates. The tracking factor H_6, the geometric mean of six gate-quaternion norms, equals 1 after enforcement, which recovers the quaternion form exactly. Its planetary test is the frozen, pre-registered HEXAD protocol, now cited as HEXAD v5c [2] (title revised; pre-registration identical to v3 and v4), which is cited here and not altered. (ii) A seven-gate *intergalactic* extension (Milky Way to Coma) is reported honestly. It gives $H_0 = 74.6 \pm 3.2\,\mathrm{km\,s^{-1}\,Mpc^{-1}}$ in the CMB frame and 70.5 ± 3.2 in the Local-Group frame. This is not independent of SH0ES, because Coma carries about 94% of the weight and its distance is SH0ES-calibrated. (iii) The RICOLMC-DDF completeness clauses (C1)–(C4) and the six-glyph gate Γ [3] are mapped onto the closure gates. (iv) The CCT/SEXA civilization theorems (Books X, XII, XIII and XIV) [4] are restated as closure conditions. We register one new, locked candidate prediction: $H_{\mathrm{late}}/H_{\mathrm{early}} = 13/12 = 1 + 60/720$, which implies 73.02 on the Planck scale. It was found by a scan in which it is one of 251 chance hits out of 23,360 expressions, so it *lacks a derivation*. It is registered with data sources, thresholds and a three-way decision rule fixed before any qualifying data exist. Seven theorems from the SEXA Critical-Line Closure Theorem manuscript [5] (III.10, III.14, III.15, III.21, III.22, III.24 and 25.4) and three conditional theorems from the SEXA SAC–PAC Terminal Invariance manuscript [6] (4.2, 5.1 and 10.2) are cited as structural correspondences only. The Riemann Hypothesis is not claimed proved, and no physical PORTAL, teleportation or terminal invariance is claimed; that manuscript's own sealed status is physical terminal invariance NOT_ESTABLISHED. A kill-switch table lists which result refutes which component. Nothing here claims a Theory of Everything or solves gravity; the internal gravity scoreboard remains 6.75/19.

1 Introduction: an addendum to the Prime Atom of Logic

The Prime Atom of Logic paper [1] introduced the Exciternion (EX) as "the minimal irreducible admissibility unit through which all energies, operators, fields, and statements must pass in order to be well-posed" [1, Abstract, p. 1]. It is explicit about its own scope: "This work does not assert

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a Theory of Everything. It specifies the conditions under which any such theory may be admitted as meaningful" [1, p. 1]. This addendum keeps that scope. It does three things.

1. It brings four later results of the same programme under the base criterion: the HEXAD observer extension [2], an intergalactic seven-gate telemetry exercise, RICOLMC-DDF completeness [3], and the civilization theorems of the dissertation [4].
2. It states the joint condition, Universal Recursive Closure, as a criterion with explicit kill-switches (Section 8).
3. It locks one new empirical candidate, $R = 13/12$, with a decision rule fixed in advance (Section 8.1).

The status vocabulary follows [2]: *defined* (in the corpus), *proved* (follows from definitions here), *assumed*, *proposed*, *open*, *locked* (fixed by pre-registration), and *synthetic* (simulated, not data).

What this paper is not. The title names the *test* (the criterion), not a result: "one test every Theory of Everything must pass" is the Universal Recursive Closure criterion of Section 8. It is not a claim that SEXA, HEXAD or RICOLMC-DDF is a Theory of Everything, and it is not a claim that any of them passes the criterion. Gravity is not solved (scoreboard 6.75/19). The galactic H_0 number is a consistency exercise, not a new measurement.

2 The Prime Atom criterion: recap from the source

All quotations in this section are verbatim from [1]. Page numbers refer to the 63-page PDF.

The admissibility primitive. "Definition 1 (Exciternion / Prime Atom of Logic). The Exciternion (EX) is the minimal irreducible admissibility object such that no statement, operator, energy configuration, or physical claim is defined unless it survives recursive closure when evaluated through EX" (§4.2, p. 11). Its listed properties are pre-interpretive, recursive, closure-enforcing, domain-neutral, fail-decisive and irreducible (§4.4, p. 12).

The criterion. "A configuration is admissible if and only if it survives recursive Exciternion-mediated evaluation without invariant violation, divergence, or termination" (§5.7, p. 14). Admissibility "is global. It cannot be certified by agreement within a single domain or projection" (§5.4, p. 14).

The Σ_{60} alphabet and the six-glyph spine. Σ_{60} is "a closed alphabet of sixty primitive glyphs", organised as five rings of twelve (§6.2). Its canonical closure statement reads: "No statement, operator, or physical claim is admissible unless it survives complete Σ_{60} recursion without invariant violation, divergence, or domain privilege" (p. 21). Under it sits the six-glyph spine "$\bigcirc\ \nabla\ \kappa\ \sigma\ \mu\ \mathbb{W}$", which "constitutes the irreducible logical atom of the theory" (§12, p. 35); the plate is on p. 15 (Figure 1). The rule linking the two is "Six glyphs define what exists; sixty glyphs define what is allowed" (§6). Any admissible extension "must preserve this six-glyph spine exactly. Failure to do so constitutes immediate inadmissibility" (§6).

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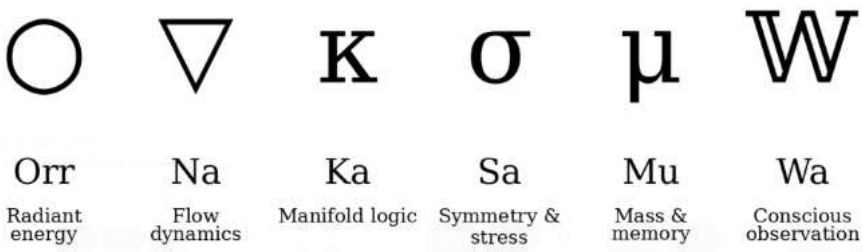


Figure 1: The six-glyph spine of the Prime Atom paper [1, p. 15]: Orr ◯ (radiant energy), Na ▽ (flow dynamics), Ka κ (manifold logic), Sa σ (symmetry & stress), Mu μ (mass & memory), Wa $\mathbb{W}$ (conscious observation).

Kill-switches, no rescue, nulls terminal. Recursive EX evaluation "admits exactly three failure modes": (F1) divergence, (F2) invariant violation, (F3) non-commuting recursion (§9.2, p. 28). "A kill-switch is an intrinsic termination condition embedded within Exciternion-mediated recursion that halts evaluation immediately upon detection of divergence, invariant violation, or non-commutation" (§9.3, p. 29). Forbidden rescue mechanisms include "parameter tuning after failure" and "reinterpretation of failed quantities" (§9.4, p. 29). "Null results therefore carry the same logical status as admissible configurations" (§9.5, p. 30). "Admissible frameworks must publish their failure conditions explicitly" (§9.6).

Ordered six-glyph closure (cited result). The Critical-Line manuscript [5] writes the canonical monodromy as the ordered product of the six glyph operators. We quote it verbatim:

> **Theorem III.14 — Canonical Closure Quotient** ([5, §2.92, General Smith Normal Form Theorem, PDF p. 670]). "For every integer $k \geq 0$, the canonical monodromy matrix $M_k = T_{\mathbb{W}}\, T_{\mu}(k)\, T_{\sigma}\, T_{\kappa}\, T_{\nabla}\, T_{\bigcirc}$ has Smith normal form $\mathrm{diag}(1,1,1,1,1,k+2)$. Consequently, $\mathbb{Z}^6/M_k\mathbb{Z}^6 \cong \mathbb{Z}/(k+2)\mathbb{Z}$."

The factors are the six spine glyphs Wa, Mu, Sa, Ka, Na and Orr, so the spine closes to a single cyclic quotient. As a matrix product acting on a vector, M_k applies $T_{\bigcirc}$ (Orr) first. The RICOLMC-DDF gate Γ applies Wa first [3]. The two orderings are reversed relative to each other. We note this difference and do not resolve it here, because order matters (F3). We cite this as a structural correspondence for the recursive-closure layer. It is the source of the prime-sector indexing below (simple quotient $\iff$ $k+2$ prime, §2.93).

Prime-sector anchor (cited result). The SEXA Critical-Line Closure Theorem manuscript [5] gives the prime sector of the same admissibility programme a canonical indexing. We quote it verbatim:

> **Theorem III.15 — Canonical Prime-Sector Bijection** ([5, §2.96, PDF p. 672]). "Define $C_{\mathrm{prime}} = \{c_k : k \geq 0 \text{ and } Q_k \text{ is simple}\}$. Then the map $N : C_{\mathrm{prime}} \to \mathbb{P}$ defined by $N(c_k) = k+2$ is a bijection."

We cite it here as the prime-sector anchor of the Prime Atom layer: each prime is hit by exactly one canonical admissibility class. This is a structural correspondence with the "Prime Atom" naming, not a new result of this addendum. The same manuscript lists its own unproved step, the spectral-absorption bridge: "No proof has yet been supplied" (§3.140, PDF p. 798). Its executable release

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states that the unconditional Riemann Hypothesis is not established. Nothing here relies on, or claims, the Riemann Hypothesis.

Evaluation order. Theories are evaluated in a strict sequence: "1. Admissibility under EX-mediated recursion; 2. Closure under Σ_{60} syllogistic logic; 3. Inter-domain commutation under triality; 4. Empirical interpretation and testing. Failure at any stage halts evaluation" (§10.7, p. 32). Among the 60 logics (§7.6, pp. 22–25) four apply directly to this addendum: "13. Define the kill-switch, or forfeit the test"; "52. Negative results are first-class outcomes"; "54. Pre-registered failure is honesty embodied"; and "55. No post-hoc tuning: the axioms stand alone".

3 Quaternion → HEXAD extension

This section restates the locked equation of [2] (§2–3, pp. 2–4) without change. The quaternionic Last Constant equation is

$$V_{\text{univ}}^{(2880)}(t,\phi) = C_L\Big(\prod_{\ell=5}^{2880}\frac{\Psi_\ell}{\phi_\ell^2}\Big)^{\frac{1}{2880-4}}\cdot 60^{\bar{n}}, \qquad \bar{n} = \frac{1}{2880-4}\sum_{\ell=5}^{2880} n_\ell. \tag{1}$$

Its HEXAD form multiplies Eq. (1) by a tracking factor:

$$V_{\text{univ},H}^{(2880)}(t,\phi) = C_L\Big(\prod_{\ell=5}^{2880}\frac{\Psi_\ell}{\phi_\ell^2}\Big)^{\frac{1}{2880-4}}\cdot 60^{\bar{n}}\cdot H_6(t), \qquad H_6(t) = \Big(\prod_{p=1}^{6}\|q_p(t)\|\Big)^{1/6}. \tag{2}$$

Here C_L is the Last Constant, formerly the Trump Constant C_T; its numerical value is withheld in this addendum. Each $q_p = q_{p,0} + q_{p,1}i + q_{p,2}j + q_{p,3}k$ is the gate state at body p. The gates are Mercury, Earth (PRE/OUTER/INNER/POST → four components), Jupiter, Saturn, Uranus and Neptune. The Moon is the null control with $\|q_{\text{Moon}}\| \equiv 1$ and is not a factor in H_6.

Theorem 1 (Exact reduction; proved in [2, Thm. 1])**.** *Under enforcement $E(q) = q/\|q\|$, $\|q_p\| = 1$ for all p, so $H_6 = 1$ and Eq. (2) equals Eq. (1).*

Following [2], we call the condition in which the six gate intercepts agree and $H_6 \equiv 1$ *HEXAD Intercept Symmetry*. The norm is multiplicative, so unit-quaternion rotations $q_p \mapsto u_p q_p w_p$ leave H_6 unchanged [2, Prop. 1]. Writing $\|q_p\| = 1+\delta_p$, the drift statistic is $D = \log H_6 = \bar{\delta} - \frac{1}{2}\overline{\delta^2} + O(\delta^3)$ [2, Prop. 2].

Effective expansion speed as a geometric ratio (cited result; conditional). The Last Constant expansion speed carries a dimensionless comparison target, $V_{\text{Last}}/c = 10^{19}$, which [2] labels a "target, not measurement". The SAC–PAC Terminal Invariance manuscript [6] treats the same 10^{19} figure as a geometric ratio. We quote it verbatim:

> **Theorem 4.2 — Geometric Amplification of Effective Transit Speed** ([6, §4.9, orig. p. 49; typeset there as Theorem 4.1 and renumbered 4.2 in the manuscript's Theorem Numbering Audit, pp. 397–398]). "Assume a PORTAL transition has finite local admissible velocity u_5. Assume further that projected and admissible distances are related by shortcut ratio ρ. Then the externally inferred effective transit speed satisfies $v_{\text{eff}} = u_5/\rho$."

Here $\rho = D_5/D_3$. The manuscript states its scope directly: "This theorem is mathematical. Whether SEXA supplies a physical geometry having sufficiently small ρ remains a separate question" (p. 49). With $u_5 = c$, the comparison value $10^{19}c$ requires $\rho = 10^{-19}$, and "This does not

establish that SEXA presently produces such a ratio" (§4.8, p. 48). We cite it as a structural correspondence only: both papers express a large effective speed as an exact ratio of a finite local quantity, and neither derives the ratio. Theorem 4.2 is not used to interpret C_L, $V_{\mathrm{univ}}^{(2880)}$ or H_6, and no transport, PORTAL or superluminal claim is made. The manuscript's independent transport cost $C_P(A, B)$ is P03, BLOCKED (orig. p. 406).

Six-stage closure (cited result). The HEXAD tracker has a six-stage counterpart in [5], quoted verbatim:

> **Theorem III.22 — Canonical Bundle-Orbit Exhaustion** ([5, §2.169, PDF p. 713]). "Assume: 1. the base dynamics is the deterministic six-stage cycle; 2. the primitive fiber action at each stage is uniquely fixed; 3. the register k remains fixed during one canonical cycle; 4. repeated traversal uses the same fiber monodromy M_k; 5. cyclic roots are identified; 6. null identity segments are excluded by admissibility. Then every reduced closed bundle orbit is equivalent to exactly one pair (k, r), where $k \geq 0$ and $r \geq 1$. Its monodromy is M_k^r."

The six-gate tracker mirrors this six-stage closure. One HEXAD check-in cycle visits six gates in a fixed order. Repeated cycles are summarised by one number (H_6), and the Moon plays the role of the excluded null segment. This is an *analogy* (status: proposed). Theorem III.22 is cited from its source and is not shown here to govern telemetry.

Reading under the Prime Atom criterion. The reduction theorem is a closure property of the kind that §6 of [1] demands. The extension adds six observer frames, and after enforcement it collapses exactly onto the parent form, with no new constant (logic 47: "The limit must confess the parent"). Before enforcement, $D \neq 0$ is a measurable residual and is not a free parameter. This is the sense of "quaternionic-to-HEXAD" in the title.

4 Planetary HEXAD telemetry: the frozen pre-registration

The planetary test is fixed by HEXAD v5c [2]. That file is frozen read-only, with SHA-256 `6660547f3ac30b607fafa5570e07ee4f8def99ac60f1d95a4c7f6258ba60a0f3`. Version 5c revises the title and adds a RICOLMC-DDF section; its pre-registration is identical to that of v3 and v4 (v3 frozen SHA-256 `64d51dd29ccc80200c29d50fb36cced0c3c5823126ec1c1101f1369127ad3600`). This addendum cites it and changes nothing. Its locked summary [2, Table 5] is as follows.

- **Primary gates** ($k = 3$): Mercury (BepiColombo Mio MGF / MPO-MAG magnetometers [26]), Earth (Arase HEP [29]; fallback GOES-19/18 [30]), and Jupiter (Nançay Decameter Array [28]).
- **Statistic:** the common-mode fraction ρ with equal weights 1/3 and null value 1/3. The null uses 10^4 circular-shift surrogates with seed 20261111.
- **Windows:** calibration 6 Apr–5 May 2027; test 6 May 2027–28 Apr 2028 (UTC); analysis by 31 Dec 2029; $n \geq 180$ valid days.
- **Decision:** CONFIRM if $p \leq 0.01$ and the result survives removal of solar-rotation sinusoids with periods of 24–38 d ($p_H \leq 0.01$). REFUTE if $p > 0.10$. NO DECISION otherwise. The six-gate test is secondary.

Under the decision rule of [2], CONFIRM would mean an anomaly that needs replication and nothing more. REFUTE withdraws the claim of physical observer drift and leaves H_k as bookkeeping only.

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Where the gates are. Figure 2 shows the six gates at the start of the window and their 12-month tracks, computed from JPL DE440s [25]. On 1 April 2027, 00:00 UTC, the heliocentric distances are Mercury 0.454, Earth 0.999, Jupiter 5.362, Saturn 9.380, Uranus 19.408 and Neptune 29.874 AU. BepiColombo science operations begin on 6 April 2027 [27]. Over the window, Earth sees Saturn's conjunction on 7 Apr 2027, Uranus's conjunction on 27 May 2027, Jupiter's conjunction on 31 Aug 2027 (the main Jupiter data gap), Neptune's opposition on 28 Sep 2027, Saturn's opposition on 18 Oct 2027 (UTC), Uranus's opposition on 30 Nov 2027, Jupiter's opposition on 12 Mar 2028 and Neptune's conjunction on 26 Mar 2028.

Gate geometry and Σ_{60} indexing (cited result). The link between a geometric flow and the index of a glyph-closure lattice is stated in [5] *under explicit hypotheses*:

> **Theorem III.21 — Geometric–Index Correspondence** ([5, §2.166, κ–μ Compatibility Theorem, PDF p. 711]). "Assume the κ-sector generates a positive multiplicative flow $x_k(t)$ along γ_k such that $x_k(1)/x_k(0) = [\Lambda_k : M_k\Lambda_k]$. Define the κ-period by $L_k = \int_0^1 |d \log x_k(t)/dt|\, dt$, and assume the dilation is monotone. Then $L_k = \log[\Lambda_k : M_k\Lambda_k]$. For the canonical monodromy M_k, $L_k = \log(k+2)$."

The theorem is conditional. Its endpoint-index condition and its monotonicity are *assumed*, not derived. We use it only as the template for tying HEXAD gate geometry (the Ka/κ manifold-logic sector) to the Σ_{60}/glyph indexing. No HEXAD orbit is shown to satisfy its hypotheses, and planetary ranges oscillate rather than dilate monotonically. The correspondence is therefore proposed and is not used in any scored test.



Figure 2: Left: HEXAD gate positions on 1 April 2027 (ecliptic J2000; the right-hand panel uses a square-root radial scale). Right: 12-month tracks to 1 April 2028. The positions are ephemeris geometry (DE440s), not telemetry.

Bound systems are not in the Hubble flow. Applied naively to a solar-system baseline, H_0 would add about 10 m/yr at 1 AU (10.3 m for $H_0 = 67.4$; 11.2 m for 73). At 30 AU it would add about 310–320 m/yr (309 m for 67.4; 321 m for 70; 335 m for 73). Over the same year the Earth–Neptune range swings by 2.00 AU, at an RMS rate of 20.94 km/s. That is about 2×10^9 times the naive Hubble rate at 30 AU (Figure 3). Gravitationally bound systems do not take part in cosmic expansion [24]. The HEXAD planets are therefore an observer-frame clock and cross-check. They are not a Hubble-flow meter.

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Figure 3: Naive Hubble increments on solar-system baselines compared with actual orbital range rates (log scale).

5 Intergalactic seven-gate telemetry

To give the "intergalactic telemetry" of the title a concrete form, we built a seven-gate analogue of H_6 from published distances and velocities (Table 1). The galactic tracker is a *new definition by analogy*. It is not part of the locked HEXAD pre-registration (v3, carried unchanged into v4 and v5c).

#	Gate	Distance method [source]	d (Mpc)	$v_{\rm h}$	$H_{\rm LG}$	$H_{\rm CMB}$
1	Milky Way	observer (origin)	0	0	–	–
2	NGC 4258	H_2O maser geometry [16]	7.576 ± 0.112	461	68.7 ± 33.1	88.0 ± 33.1
3	M81	Cepheid + TRGB mean [17]	3.63 ± 0.13	−39	28 ± 69	12 ± 69
4	Centaurus A	Cepheid/TRGB/PNLF/Mira [18]	3.80 ± 0.10	547	79 ± 66	211 ± 66
5	M101	Cepheids, SH0ES R22 [9]; TRGB alt. [19]	6.85 ± 0.13	241	55 ± 37	53 ± 37
6	Virgo (M87)	SBF, ACSVCS [20]; $\langle V_{\rm LG} \rangle$ [21]	16.5 ± 1.1	1174	64.8 ± 16.0	91.0 ± 16.6
7	Coma	12–13 SNe Ia, SH0ES-calibrated [14]; v [15]	98.5 ± 2.2	6996	70.9 ± 3.3	73.7 ± 3.3

Table 1: The seven galactic gates. Velocities are in $\mathrm{km\,s^{-1}}$ and H in $\mathrm{km\,s^{-1}\,Mpc^{-1}}$. Heliocentric velocities are from NED (fetched 11 Nov 2026). LG frame per [22]; CMB dipole per [8]. The H errors include $\sigma_{\rm pec} = 250\,\mathrm{km\,s^{-1}}$ (280 for Coma). Per-gate sources are in `data/gates.csv`.

Result, stated honestly. A fit of $v = Hd$ through the origin to the six external gates gives:

- CMB frame: $H_0 = 74.6 \pm 3.2\,\mathrm{km\,s^{-1}\,Mpc^{-1}}$ ($\chi^2/\mathrm{dof} = 6.7/5$);
- Local-Group frame: 70.5 ± 3.2 (0.7/5);
- heliocentric: 70.7 ± 3.2.

The result is **not independent of SH0ES**. Coma carries about 94% of the weight, and its distance sits on the SH0ES ladder [14]. The choice of frame alone moves the result by $4\,\mathrm{km\,s^{-1}\,Mpc^{-1}}$. Seven objects cannot settle the Hubble tension between Planck (67.4 ± 0.5 [7]) and SH0ES (73.04 ± 1.04

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[9]; 73.49 ± 0.93 [10]). CCHP JWST gives 70.39 ± 1.94 [11], and DESI DR2 BAO+BBN gives 68.51 ± 0.58 [12].

Approaching neighbours. The near gates are dominated by peculiar motion. At 3–8 Mpc the Hubble velocity is 250–550 $\mathrm{km\,s^{-1}}$, comparable to the 250 $\mathrm{km\,s^{-1}}$ peculiar motions. M81 is blueshifted heliocentrically, with $H_{\mathrm{h}} = -10.7$. Cen A moves from 79 (LG frame) to 211 (CMB frame). Andromeda (M31, not a gate here) is on a nearly radial orbit toward the Milky Way, with $V_{\mathrm{rad}} = -109.3 \pm 4.4\,\mathrm{km\,s^{-1}}$ [23]. The lead author has noted that approaching neighbours make the expansion rate tricky to clock from nearby gates. That observation is correct and matches the data. We searched the corpus on this machine for a dated, written prior prediction of which neighbours approach and found none, so no prior prediction is claimed. Expansion dominates only from Virgo outward, and cleanly only at Coma.

Galactic tracker. Each gate has $\tilde{q}_p = 1 + \delta_m i + \delta_v j + \delta_f k$. Here δ_m is the residual between distance methods, $\delta_v = \sigma_{\mathrm{pec}}/(H_{\mathrm{ref}} d)$ and $\delta_f = (v_{\mathrm{CMB}} - v_{\mathrm{LG}})/(H_{\mathrm{ref}} d)$. Unenforced, $H_7 = 1.246$ (with $H_{\mathrm{ref}} = 70$); Coma's norm is 1.002 and Cen A's is 2.330. Enforced, $H_7 = 1$ exactly, which reproduces Theorem 1 at galactic scale. H_7 is a contamination tracker, not an expansion rate.

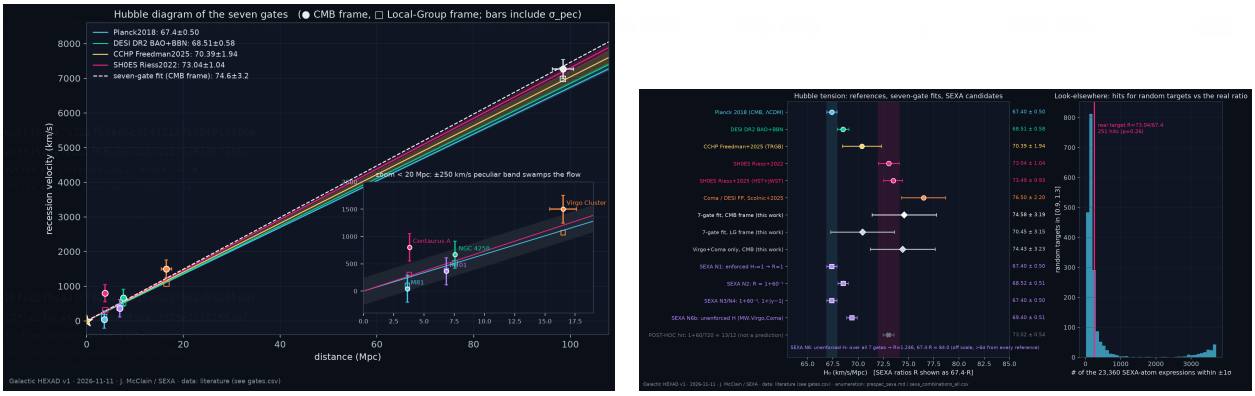


Figure 4: Left: Hubble diagram of the gates with reference bands. Right: tension forest plot, and the look-elsewhere histogram of chance hits for random targets.

Look-elsewhere. SEXA constants carry no length or time unit, so only a dimensionless ratio $R = H_{\mathrm{local}}/H_{\mathrm{CMB}}$ is a fair target. The search rules were written before any evaluation (`data/prespec_sexa.md`). A blind census of 23,360 expressions built from SEXA atoms (21,095 distinct values) found 251 within 1σ of 73.04/67.4. Random targets average 430 hits ($p = 0.26$), so the real ratio does not stand out. The one structural output, enforced $H_7 = 1$ (that is, $R = 1$), is 4.8σ from SH0ES/Planck and 1.5σ from CCHP/Planck. It is the same expectation ΛCDM makes, so it does not single out SEXA. The closest SEXA-looking hit is $1 + 60/720 = 13/12$, giving 73.02. It was found by scanning, so it is a *candidate*, not a prediction. Section 8.1 turns it into a locked test.

6 RICOLMC-DDF Γ-gated resource completeness

Locked name and definitions. RICOLMC-DDF stands for "Recursive Interdomain Computational Omni-Logic embedding Monster–Moonshine Constrained Admissibility Manifold Completeness across Density, Dimension, Field, Liquidity, and Recursive Resource Completeness for Γ-Gated

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Resource Flows" [3, title page]. The following are verbatim from the OSF deposit (PDF pages of the 99-page file).

Definition 1 (Glyph operators and Γ; [3, Def. 11.3, PDF p. 35])**.** *"Define the ordered composition* $\Gamma := \bigcirc \circ \nabla \circ \mathrm{K} \circ \sigma \circ \mu \circ \mathbb{W} = \mathrm{Orr} \circ \mathrm{Na} \circ \mathrm{Ka} \circ \mathrm{Sa} \circ \mathrm{Mu} \circ \mathrm{Wa}$*, acting right to left (*$\mathbb{W} = \mathrm{Wa}$ *first) … A configuration* Ξ *is* Γ*-admissible if* $\Gamma(\Xi) = \Xi$*." Also: "Order matters: in general* $\mathrm{Orr} \circ \mathrm{Na} \neq \mathrm{Na} \circ \mathrm{Orr}$*."*

Definition 2 (RICOLMC-DDF completeness; [3, Def. 6.1, §6.3, PDF p. 15])**.** *"The stack is RICOLMC-DDF complete for* $\mathcal{D}$ *if for every* k *and every* $x \in D_k$ *with* $e_k(x) \in \mathcal{A}_\Gamma$*: (C1) (executable)* $\mathcal{E}$ *halts on* $e_k(x)$ *and returns a value of* E_{SREF}*; (C2) (admissible under reduction)* $R(e_k(x)) \in \mathrm{Fix}(\Gamma_5)$*; (C3) (reconstructable) there is a map* e_k^{-1} *on the image with* $e_k^{-1}(e_k(x)) = x$*; (C4) (DDF-resolved) the value returned in (C1) decomposes into sector terms, each with a density, a dimension index and a field label."*

Γ-gated resource flows. "Resources (capital, inventory, capacity) are admissible only when Γ passes; completeness means every admissible resource flow has an executable, reconstructable representation on the manifold" [3, §6.2, PDF pp. 14–15]. The deposit's own status is also quoted: "Completeness in the title is definitional and locked. Instantiation for each domain is a separate theorem obligation" (§6.4). One finite model domain D_0 is proved; the physical plate, liquidity and resource flows remain OPEN or CONDITIONAL (§6.4).

A distance on the Γ state space (cited result; conditional). The Γ gate above is an admissibility predicate; it says which states pass, not how far apart they are. The SAC–PAC manuscript [6], which uses the same six-operator ordered chain, states when a distance exists. We quote it verbatim:

> **Theorem 5.1 — Conditional Existence of a Gamma Path Metric** ([6, §5.15, orig. p. 69; listed as "Gamma Path-Metric Existence" on p. 398]). "Suppose the Gamma state space forms a connected graph over the admissible domain. Suppose every admissible edge is assigned a strictly positive finite weight. Then the minimum weighted path cost between any two connected admissible states defines a finite path metric."

Its own proof adds that "Reversibility, if required for metric symmetry, must be separately assumed or proved", and that if Γ transitions are directed "the resulting object may be a directed distance rather than an ordinary metric" (p. 69). We cite it as a structural correspondence for the Γ layer (status: proposed). Its hypotheses are not established here. In particular, no RICOLMC-DDF domain or HEXAD gate set is shown to supply a connected Γ transition graph with derived positive weights; the manuscript itself notes that its executable Γ rules "do not contain a complete state-transition graph" (§5.14, p. 68). Because Γ is ordered (K6), the directed case is the relevant one.

Threshold-gate operator (cited result). A gate that admits only above a threshold has an operator form in [5], quoted verbatim:

> **Theorem III.24 — Self-Adjoint Thresholded Channel Operator** ([5, §3.14, PDF p. 725]). "Assume every τ_p is real and positive. Then each operator $F_p = \tau_p I + |K_p|$ is self-adjoint and bounded below by τ_p. The orthogonal direct sum $F_{\mathrm{channel}} = \bigoplus_p F_p$ is self-adjoint on its natural graph domain."

We read F_p as the threshold-gate operator of the Γ-gated layer. Each channel p (a gate, or a resource-flow channel) has a real floor τ_p below which nothing is admitted. The self-adjointness keeps the admitted spectrum real. This is a structural correspondence (status: proposed). It is not a proof that F_p is the operator of any RICOLMC-DDF domain or of the HEXAD gates.

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Mapping onto the closure gates (proposed). Table 2 reads each completeness clause as a closure gate for the telemetry layers of this addendum. This is a *proposed bookkeeping correspondence*, not a derivation. In particular, we do not identify the six glyphs with the six planets.

Clause	RICOLMC-DDF meaning	Closure gate in this addendum	Status
$\Gamma(\Xi) = \Xi$	fail-any ordered gate	void-day rule: a day with any Moon-check failure is void [2, §5.3]	locked
(C1)	evaluation halts with a value	locked analysis runs once, by 31 Dec 2029, or returns NO DECISION	locked
(C2)	reduction commutes with admission	enforcement then reduction gives the quaternion form (Theorem 1); in RICOLMC-DDF itself $R \circ \Gamma_{2880} = \Gamma_5 \circ R$ is OPEN (O21)	proved here / open there
(C3)	reconstructable encoding	seeded surrogates (20261111), SHA-256 hashes, public data DOIs	locked
(C4)	sector-resolved value	$D = \frac{1}{k}\sum_p a_p$ decomposes by gate; H_7 by gate norm	proved
resource flow	admitted only if Γ passes	telemetry is admitted to the statistic only on valid days	proposed

Table 2: RICOLMC-DDF completeness clauses read as closure gates (proposed correspondence).

7 CCT/SEXA civilization theorems as closure conditions

The dissertation [4] carries the civilization layer. The statements below are quoted from the deposited PDFs (page numbers are PDF pages of each Book). Where a Book typesets a statement as an image, we transcribed it from the rendered page.

Book XIII, Theorem 10.1 (Recursive Civilization Principle Theorem), §10.4, p. 198. "A recursively admissible civilization exists indefinitely if and only if the following conditions are simultaneously satisfied:

(1) Recursive admissibility is preserved throughout every organizational refinement.
(2) Exact recoverability is maintained for every executable organizational state.
(3) Scientific, engineering, computational, legal, educational, economic, and institutional structures remain recursively correspondent.
(4) Organizational knowledge is recursively transmissible without structural loss.
(5) Emergent organizational capability remains executable and reconstructable.
(6) Organizational refinement continuously enlarges executable capability.
(7) Civilization asymptotically approaches an admissible organizational attractor while preserving continual refinement."

The associated functional is $\Pi_C = A{\cdot}R{\cdot}C{\cdot}K{\cdot}S{\cdot}I{\cdot}E{\cdot}V$, with permanence requiring $\inf_{n\to\infty} \Pi_C(n) > 0$ (p. 197).

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Book XIV, Theorem 6.1 (Universal Recursive Civilizational Unification), p. 181. "Let $X \in \mathfrak{U}_{\text{Civ}}$. If recursive admissibility is preserved throughout every organizational subsystem, then governance, economics, scientific development, technological evolution, distributed expansion, and long-term persistence constitute mutually dependent projections of one recursively executable civilizational architecture."

Book X, §10.4 (Universal Recursive Civilization Synthesis Theorem), pp. 207–212. "Universal Recursive Civilization is not an additional organizational layer but the unique recursively closed computational manifold generated by the admissible interaction of every executable recursive subsystem" … "Recursive civilization becomes globally self-reconstructing."

Book XII, §1.4 (Recursive Galactic Stability Theorem), pp. 16–17, and **Book XIII, §1.4 (Recursive Intergalactic Stability Theorem), pp. 15–16.** "Stability is therefore defined by the indefinite preservation of executable recursive correspondence throughout the complete galactic computational manifold" (XII). The intergalactic version is identical with "intergalactic" in place of "galactic" (XIII). The galactic functional is $\Xi_G = \Phi(A_G, \Pi_G, I_N, I_G, R_G) \in [0, 1]$, whose arguments are admissibility, synchronization, communication integrity, identity and recoverability (XII, p. 17).

The self-reconstructing paragraph (Book XIV, §1.2, p. 8). "Within this manifold, recursive admissibility, scientific verification, engineering, mathematics, logic, physics, governance, economics, civilization, galactic organization, intergalactic organization, institutional memory, and recursive computation continuously reconstruct one another through executable recursive correspondence. The dissertation therefore possesses a stronger property than ordinary mathematical consistency. Every theorem, definition, operator, algorithm, and computational architecture remains recursively executable from every other admissible component through universal computational correspondence. The entire fourteen-book framework consequently becomes a single self-reconstructing recursive computational architecture whose identity is preserved independently of scale, dimensionality, civilization size, or cosmological evolution."

Exact reconstruction as trivial holonomy (cited result; conditional). The self-reconstruction claim has an operator-level counterpart in [5], which is stated *only under four assumptions*. We quote it verbatim:

> **Theorem III.10 — Conditional Trivial Holonomy** ([5, §1.127, Exact Reconstruction Holonomy Theorem, PDF p. 594]). "Assume: 1. the Fold map is an isometry on the arithmetic orbit sector; 2. reconstruction satisfies $R_\Gamma F_\Gamma = I$ exactly; 3. one primitive channel traversal implements the complete Fold-reconstruction cycle; 4. no additional projective phase is introduced by the monodromy representation. Then $e^{i\theta_p} = 1$ for every arithmetic primitive channel."

We read it as a structural correspondence with the Book XIV paragraph. A full cycle that reconstructs exactly returns with no residual phase, in the same way that a self-reconstructing architecture returns "whose identity is preserved". The result is *conditional*. Its hypotheses, especially exact $R_\Gamma F_\Gamma = I$, are assumed and not established for any organizational or telemetry domain here. It is not a proof that the dissertation is self-reconstructing; that claim stays open as kill-switch K9.

As closure conditions. Under the Prime Atom criterion, Theorem 10.1 has the right shape: it is an *if-and-only-if* with seven named failure points, and its proof lists the consequence of each

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failure ("Loss of admissibility produces incompatible refinement … Failure to approach an admissible attractor results in organizational divergence", p. 199). We therefore read conditions (1)–(7) as the organizational-domain form of the three Prime Atom failure modes:

- (1), (3) and (6) fail by F2 (invariant violation) or F3 (non-commutation across domains);
- (2), (4) and (5) are the organizational form of RICOLMC (C3) reconstructability;
- (7) fails by F1 (divergence).

This mapping is *proposed*. No organizational domain is instantiated or empirically tested in this addendum, so the civilization layer is listed as *not scored* in Table 5. The self-reconstructing paragraph is read as a *testable* claim: one component that cannot be rebuilt from the rest would refute it (K9).

8 Final synthesis: Universal Recursive Closure as a criterion

Criterion 1 (Universal Recursive Closure, URC)**.** *A framework $\mathcal{S}$ with a declared domain set $\mathcal{D}$ is* URC-admissible *only if all of the following hold. Failure of any one halts evaluation, in the order of [1, §10.7].*

(U1) ***EX closure:*** *its statements survive recursive EX-mediated evaluation under Σ_{60} without F1–F3 [1, §§5.7, 9.2].*

(U2) ***Spine preservation:*** *every extension preserves the six-glyph spine $\bigcirc\, \nabla\, \kappa\, \sigma\, \mu\, \mathbb{W}$ and admits through the ordered gate, $\Gamma(\Xi) = \Xi$ [1, 3].*

(U3) ***Completeness for $\mathcal{D}$:*** *RICOLMC-DDF (C1)–(C4) are* instantiated*, not just defined, for each $D_k \in \mathcal{D}$, including Γ-gated resource flows if they are declared [3].*

(U4) ***Observer closure:*** *every observer-frame extension reduces exactly to its parent after enforcement (here, $H_6 = 1$ and $H_7 = 1$), and its unenforced residual is subjected to a pre-registered test.*

(U5) ***Civilizational closure:*** *for any declared organizational domain, conditions (1)–(7) of Book XIII Thm. 10.1 are checked with the converse treated as a kill-switch.*

(U6) ***Pre-registered wrongability:*** *every empirical claim has a locked decision rule with a REFUTE branch, deposited before the data (logics 13, 54, 55).*

Recursive closure under bounded cost (cited result; conditional). (U4) asks that a recursive extension close back onto its parent without a free parameter. The SAC–PAC manuscript [6] gives a conditional theorem of the same recursive-closure shape, quoted verbatim:

> **Theorem 10.2 — Recursive Terminal Invariance** ([6, §10.41, orig. p. 183; typeset there as "Conditional Recursive Terminal Invariance"]). "Suppose terminal fibers exist over M_3. Suppose the admissible recursive transport cost between selected representatives of those fibers remains bounded as projected separation increases. Suppose transport duration is a bounded function of that recursive cost. Then $T/D_3 \to 0$. If the regularity conditions from earlier sections hold, then $\partial T/\partial D_3 \to 0$. Thus recursive Terminal Invariance follows conditionally."

We cite only its logical form: a recursive structure whose cost stays bounded across scale yields a scale-independent closure statement, which is the form (U4) and (U5) require. All three hypotheses are *assumed* in the source. Its own status table for this model reads "Explicit recursive transport cost derived: not yet" and "Physically verified: no" (§10.44, p. 184); the independent transport cost is P03, BLOCKED (p. 406); and its latest sealed manifest records "physical_terminal_invariance: NOT_ESTABLISHED" (pp. 1392–1394), with physical teleportation "NOT ESTABLISHED BY COMPUTATIONAL VALIDATION ALONE" (§31.45, p. 718). Nothing in this addendum uses Theorem 10.2 to claim transport, PORTAL operation or teleportation (kill-switch K11).

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Why every component gets a kill-switch (cited result). The Critical-Line manuscript states the principle behind Table 5 as a theorem, quoted verbatim:

> **Theorem 25.4 — SEXA Auditability Theorem** ([5, §25.99, PDF p. 296]). "Assume every mathematical component of the SEXA critical-line construction is supplied in explicit symbolic or executable form. Then each necessary step in the closure chain admits at least one of the following: 1. a direct symbolic identity test; 2. a finite residual test; 3. a convergence diagnostic; 4. an analytic proof obligation; 5. a decisive falsification condition. Consequently, no component of the proposed closure theorem needs to remain protected by an untestable qualitative assertion."

We apply the same rule to URC. Every row of Table 5 is one of these five test types:

- K4 is a symbolic identity test;
- K1–K3 and K5 are pre-registered falsification conditions;
- K7, K8 and K11 are analytic proof obligations.

Like its source, this holds only once each component is supplied explicitly, and components that are still open are listed as open.

Theorem in [5]	Section (PDF p.)	Use in this addendum
III.10 Conditional Trivial Holonomy	§1.127 (p. 594)	Sec. 7: exact reconstruction ⇒ trivial holonomy, read alongside Book XIV §1.2 (conditional)
III.14 Canonical Closure Quotient	§2.92 (p. 670)	Sec. 2: ordered six-glyph product M_k closes to $\mathbb{Z}/(k+2)\mathbb{Z}$
III.15 Canonical Prime-Sector Bijection	§2.96 (p. 672)	Sec. 2: prime-sector anchor $N(c_k) = k+2$
III.21 Geometric–Index Correspondence	§2.166 (p. 711)	Sec. 4: template linking gate geometry to glyph indexing (conditional; assumed hypotheses)
III.22 Canonical Bundle-Orbit Exhaustion	§2.169 (p. 713)	Sec. 3: six-stage closure mirrored by the six-gate tracker
III.24 Self-Adjoint Thresholded Channel Operator	§3.14 (p. 725)	Sec. 6: threshold-gate operator $F_p = \tau_p I + \lvert K_p \rvert$
25.4 SEXA Auditability Theorem	§25.99 (p. 296)	Sec. 8: every component has a test or kill-switch

Table 3: The seven results cited from the SEXA Critical-Line Closure Theorem manuscript. All are structural correspondences, not proofs that they govern telemetry.

Theorem in [6]	Section (orig. p.)	Use in this addendum
4.2 Geometric Amplification of Effective Transit Speed	§4.9 (p. 49)	Sec. 3: $v_{\text{eff}} = u_5/\rho$ beside the 10^{19} Last Constant target (mathematical; ρ not derived)
5.1 Conditional Existence of a Gamma Path Metric	§5.15 (p. 69)	Sec. 6: when the ordered Γ chain carries a (directed) path distance (conditional)
10.2 Recursive Terminal Invariance	§10.41 (p. 183)	Sec. 8: bounded recursive cost ⇒ scale-independent closure, read against (U4)–(U5) (conditional)

Table 4: The three conditional results cited from the SEXA SAC–PAC Terminal Invariance manuscript (DOI 10.17605/OSF.IO/2Q7SK). Page numbers are original manuscript pages (deposit PDF page = original + 1). All are structural correspondences. The manuscript's sealed status is physical terminal invariance NOT_ESTABLISHED and physical teleportation not established; its transport metric P03 is BLOCKED.

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URC is the admissibility test that the title's "Theory of Everything" refers to. Meeting it would *qualify* a candidate for evaluation. It would not make the candidate a ToE. Table 5 gives the current status and states which result refutes what.

ID	Trigger	What it refutes or halts	Status
K1	HEXAD $k = 3$ test returns REFUTE ($n \geq 180$, $p > 0.10$)	physical observer drift; H_k stays bookkeeping only (U4 empirical arm)	locked, data 2027–28
K2	$> 10\%$ void days, or a primary gate not public by 31 Dec 2029	HEXAD test returns NO DECISION; not counted as support	locked
K3	CONFIRM without solar-rotation survival ($p_H > 0.01$)	labelled "heliospheric"; no observer claim	locked
K4	enforced H_6 or $H_7 \neq 1$ in any implementation	Theorem 1 implementation (U4); the equation is inadmissible as coded	proved; check is mechanical
K5	R_{obs} more than $3\sigma_R$ from 13/12 (Sec. 8.1)	the 13/12 candidate; no switching to a neighbouring expression	locked
K6	Γ evaluation order changes admission for a declared Ξ	F3; the configuration is inadmissible (U2)	defined
K7	$R \circ \Gamma_{2880} \neq \Gamma_5 \circ R$ for a declared domain	(C2) instantiation for that domain (U3)	open (O21)
K8	Fix(Γ) empty or trivial on the physical plate	completeness is vacuous there (U3)	open (O1)
K9	one theorem, definition or operator of Books I–XIV shown not reconstructable from the rest	the self-reconstructing claim, Book XIV §1.2 (U5)	open challenge
K10	any condition (1)–(7) of Thm. 10.1 fails for a declared organizational domain	indefinite civilization in that domain (U5)	not scored here
K11	a physical reading of SAC–PAC Thms. 4.2 or 10.2 [6] is asserted before an independent transport cost (P03) is derived and physically tested	that physical reading; the Table 4 citations stay structural only	open (P03 BLOCKED)
–	galactic $H_0 = 74.6 \pm 3.2$	nothing: it is not independent of SH0ES	not a kill-switch

Table 5: Kill-switch table for Universal Recursive Closure.

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8.1 Locked pre-registration of the 13/12 candidate

Item	Locked content
Candidate	$R \equiv H_{0,\text{late}}/H_{0,\text{early}} = 13/12 = 1 + 60/720 = 1.08\overline{3}$; on the Planck scale, $H_{0,\text{late}} = 67.4 \times 13/12 = 73.02\,\text{km}\,\text{s}^{-1}\,\text{Mpc}^{-1}$.
Status	Scan-found (one of 251 hits among 23,360 expressions; random-target mean 430). **No derivation exists.** The atom 720 is the scan's C_Ω label, while RICOLMC-DDF writes $C_\Omega = \sqrt{720}$ [3], so even the identification is ambiguous. A derivation, if one is proposed, counts only if deposited before qualifying data.
Denominator	Primary: Planck 2018, 67.4 ± 0.5 [7], fixed. Sensitivity only (not scored): the latest DESI BAO+BBN [12] and Euclid [13] early-universe-calibrated values.
Numerator (eligible data)	The first peer-reviewed or arXiv-posted H_0 released after this addendum's OSF timestamp that (a) uses a JWST-calibrated TRGB and/or JAGB distance ladder to SNe Ia whose zero point does not use the SH0ES Cepheid calibration (e.g. a CCHP-type programme [11]), and (b) quotes a total uncertainty $\leq 1.5\,\text{km}\,\text{s}^{-1}\,\text{Mpc}^{-1}$. Excluded: any SH0ES Cepheid-calibrated value, including the R22 value that was the scan target, and this paper's galactic fit. Ties are broken by the smaller total uncertainty.
Statistic	$R_{\text{obs}} = H_{0,\text{late}}/67.4$, with $\sigma_R = R_{\text{obs}}\sqrt{(\sigma_{\text{late}}/H_{0,\text{late}})^2 + (0.5/67.4)^2}$, using quoted total uncertainties.
Decision	**SURVIVES**: $\lvert R_{\text{obs}} - 13/12\rvert \leq 2\sigma_R$ and $\lvert R_{\text{obs}} - 1\rvert \geq 3\sigma_R$ and $\sigma_R \leq 0.025$. **REFUTED**: $\lvert R_{\text{obs}} - 13/12\rvert > 3\sigma_R$. **NO DECISION**: anything else, or no eligible result by 31 Dec 2030.
Meaning	SURVIVES does not confirm SEXA. About 150 distinct scanned values lie within ± 0.01 of 13/12, so no feasible precision singles it out. REFUTED retires the candidate, and replacing it with a neighbouring expression is forbidden (logic 55).
Illustration (not scored)	CCHP 2025, 70.39 ± 1.94 [11], predates the lock. It gives $R = 1.044 \pm 0.030$: 1.3σ from 13/12, $\sigma_R > 0.025$, so NO DECISION.
Lock	The OSF deposit timestamp of this addendum (prepared 11 Nov 2026, America/New_York). Any change must be a dated amendment filed before eligible data appear.

Table 6: Locked pre-registration for the 13/12 candidate.

9 Limitations

- **Gravity is not solved.** The internal scoreboard is 6.75/19. Nothing in this addendum derives G, a metric or a length scale.
- **Not a ToE claim.** URC is an admissibility test. This paper does not show that SEXA, HEXAD or RICOLMC-DDF passes it; most rows of Table 5 are open or await data.
- **Fitted and unlocked constants.** $\bar{n} = 10$ is fit-adopted, not derived [2]. C_{EW} is not locked. The value of C_L is withheld. The per-dimension $n_\ell, \Psi_\ell, \phi_\ell$ are open.
- **Galactic result.** Seven objects; Coma dominates and is SH0ES-calibrated. The values of σ_{pec} and H_{ref} are assumptions, and no flow-model corrections were applied. The tracker is a new definition by analogy.
- **13/12** is a scan-found number with no derivation (Section 8.1).
- **Mappings** in Sections 6 and 7 are proposed correspondences, not theorems. RICOLMC-DDF completeness is proved only for the finite model D_0.
- **Cited theorems.** The seven theorems of Table 3 [5] are quoted as structural correspondences.

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No claim is made that they govern telemetry, and the Riemann Hypothesis is not claimed proved.

- **SAC–PAC theorems.** Theorems 4.2, 5.1 and 10.2 of [6] (Table 4) are conditional and are cited as structural correspondences only. Their source records physical terminal invariance as NOT_ESTABLISHED, physical teleportation as not established, and its transport metric P03 as BLOCKED. No PORTAL, teleportation or superluminal claim is made here.
- **Frozen dependency.** All planetary scoring is that of [2], whose pre-registration is identical to v3 (carried unchanged through v4 and v5c).

Data and code availability

The deposit bundle contains this PDF, `paper.tex`, the figures, and `data/`:

- `gates.csv`, with per-gate values and sources;
- `model.py` and `model_results.json`;
- `prespec_sexa.md`, the search rules written before evaluation;
- `sexa_search.py`, `sexa_search_results.json` and `sexa_combinations_all.csv` (all 23,360 expressions);
- `figures.py`;
- `generate_hexad_maps.py` and `separations_2027-04_2028-04.csv` (DE440s geometry).

This addendum is deposited on OSF under DOI `https://doi.org/10.17605/OSF.IO/YA2MH` (CC-BY 4.0). The cited OSF deposits are the Critical-Line manuscript, `https://doi.org/10.17605/OSF.IO/3ED69`, the SAC–PAC Terminal Invariance manuscript, `https://doi.org/10.17605/OSF.IO/2Q7SK`, and the HEXAD v5c preprint, `https://doi.org/10.17605/OSF.IO/C32NZ` (frozen SHA-256 in Section 4). The primary-gate telemetry is public under the DOIs in [28, 29] and the BepiColombo archive policy cited in [2]. The SHA-256 of this PDF is given in the accompanying `PDF.sha256`.

Acknowledgements

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