Development History of the 7D 2t PLI Janus model

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Abstract

We assemble a detailed, primary-source history of the Janus–PLI framework: a seven-dimensional (7D) two-time (2t) model in which a *Principle of Least Information* (PLI) selects both geometry and dynamics. The timeline traces the shift from early variable-c probes to the axiomatic PLI regime; we list each parameter choice (what, when, why) and how it was fixed by minimal discrete data on a compact T^2. We also explain and justify the *mid-band* $1/r$ *trans-brane influence*—a scale-window modification of the gravitational response that leaves the Newtonian UV/IR intact while flattening galactic rotation curves in a finite band—and we give the MDL/PLI reasons for preferring 7D over 8D or larger. The account cross-references the Paper A unification draft (Janus geometry, compact data, and predictions) and the V14 foundations note (polarization-invariant hidden time, OS/GNS $\to$ CPTP, strong positivity, Born, Gaussian selection).

1 Scope and sources

This document is a *historical and technical* companion to the main scientific notes. It consolidates: (i) the development thread and early calculations, including the discrete-halving $c(t)$ idea and its retirement; (ii) the Paper A unification draft (Janus geometry; compact T^2 data; predictions, including the mid-band $1/r$ window) [2]; and (iii) the V14 foundations note (hidden-time OS/GNS $\to$ CPTP; strong positivity; Born; Gaussian kernel selection) [3]. The chronology and decisions are consistent with the notebook/chat record [1].

Abbreviations. PLI = Principle of Least Information; OS/GNS = Osterwalder–Schrader / Gelfand–Naimark–Segal; CPTP = Completely Positive Trace-Preserving; GKSL = Gorini–Kossakowski–Sudarshan–Lindblad; KK = Kaluza–Klein.

2 Executive timeline

1. **Early exploration: variable c by discrete steps and back-inference.** Discrete halving intervals were investigated and stress-tested against cosmology; the accumulation near $\mathcal{O}(1\text{ s})$ and observational constraints motivated a pivot from functional dials to algorithmic minimality (PLI). Notebook discussion: Sec. 1–2 [1].

2. **Axiomatic shift to PLI (algorithmic/MDL selection).** PLI is elevated to a guiding principle: among consistent histories, realised ones minimise description length $L = K(\text{law}) + K(\text{boundary}|\text{law})$. This forbids gratuitous functional *floats* (free $c(t)$ or $G(t)$) once data do not demand them. Notebook $\to$ Paper A bridge: Sec. 2–3 [1,2].

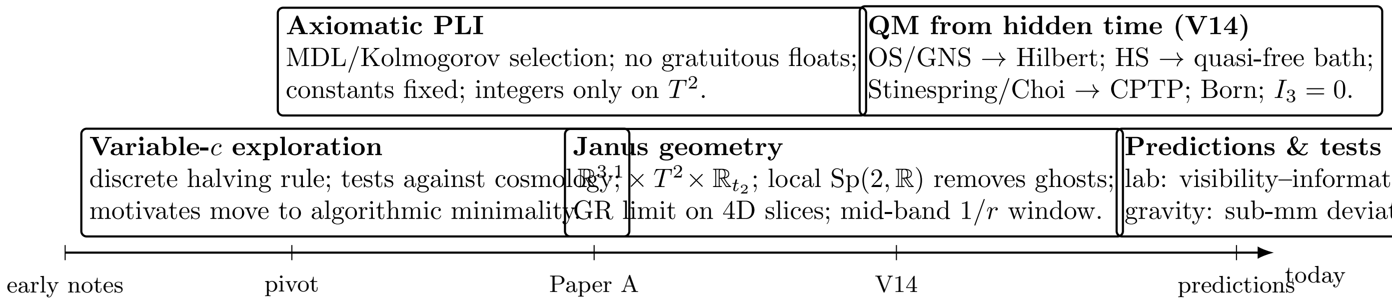
3. **Janus geometry and ghosts.** The 7D manifold $\mathcal{M}_7 \cong \mathbb{R}^{3,1} \times T^2 \times \mathbb{R}_{t_2}$ with a t_2-reflection (Janus) seam Σ_0 is adopted; a local phase-space $\mathrm{Sp}(2,\mathbb{R})$ symmetry removes extra-time ghosts, leaving a positive-norm 4D sector and GR on observable slices [2].

4. **QM from hidden time.** A polarization-invariant (t,τ) plane with a *radial* positive-definite kernel is developed; OS reflection positivity $\Rightarrow$ complex Hilbert space [4, 5]; a Hubbard–Stratonovich bridge realizes a quasi-free environment [6, 7]; Stinespring/Choi $\Rightarrow$ CPTP dynamics [8, 9]; strong positivity yields Born; quadratic influence forbids I_3 [10]; entropic PLI bounds explain complementarity via code-rate limits [11–13]. See V14 [3].

5. **Minimal compact data on T^2.** PLI picks a rectangular T^2 and the smallest nontrivial geodesics/multiplicities that reproduce $(\alpha_1, \alpha_2, \alpha_3)$ at M_Z to $\sim 2\%$ RMS: axis integer $k=3$, asymmetric color pair $(2,1)$, multiplicities $m_x = m_y = 2$, $m_{(2,1)} = 4$, and radius ratio $R_2/R_1 = \sqrt{17/7}$; couplings follow the dictionary $\alpha_i = K m_i / L_i^2$ [2].

6. **Predictions and tests.** Quantum-lab signatures (visibility–information kinks; directional Zeno), table-top gravity (sub-mm deviations), and an astrophysical *mid-band* $1/r$ window for galaxy dynamics that leaves solar-system/CMB intact [2, 14].

Graphical timeline (for slides)



Sources: notebook/chat; Paper A; foundations V14.

3 Parameter ledger: what, when, why

Parameters below are those that *survived* the PLI audit. Where a choice appears "discrete," it reflects MDL selection as documented in [1–3].

Parameter	Final choice	Where fixed / why
Manifold & seam	$\mathbb{R}^{3,1} \times T^2 \times \mathbb{R}_{t_2}$; Janus seam at $t_2 = 0$	Minimal extra structure supporting gauge isometries and hidden time; Janus enforces reflection positivity and microcausality [2].
Ghost protection	Local $\mathrm{Sp}(2,\mathbb{R})$ (first-class) constraints; BRST cohomology	Removes extra-time ghosts; leaves a single massless spin-2 pole with positive residue; no wrong-sign poles [2].
Constants	c, G *fixed* (no floats)	PLI forbids gratuitous functional dials; variable-c idea retired [1, 2].

Parameter	Final choice	Where fixed / why
Hidden-time kernel	Radial, positive-definite; *Gaussian class* (quadratic influence)	Isotropy $\Rightarrow$ radial (Schoenberg class); finite-variance stability & MDL $\Rightarrow$ Gaussian; quadratic influence $\Rightarrow I_3 = 0$ [3–5, 11–13].
OS/GNS $\to$ CPTP	OS inner product; HS bridge; Stinespring/Choi	Reflection positivity $\Rightarrow$ Hilbert; unitary dilation $\Rightarrow$ CPTP; strong positivity $\Rightarrow$ Born [3, 6–10].
Compact space	Rectangular T^2	Minimal code length while preserving needed isometries; avoids continuous complex-structure moduli [2].
Axis integer	$k = 3$	Smallest axis winding consistent with EW mixing and couplings at M_Z [2].
Asymmetric pair	$(p, q) = (2, 1)$	Minimal Pythagorean loop needed to fit α_3 [2].
Multiplicities	$m_x = m_y = 2$, $m_{(2,1)} = 4$	Janus parity and sign-reversed windings; minimal nondegenerate counting [2].
Radius ratio	$R_2/R_1 = \sqrt{17/7}$	Enforces $\alpha_2/\alpha_1 = 2$ with $k = 3$ [2].
Geodesic lengths	$L_x^2 = (kR_1)^2 + R_2^2$, $L_y^2 = (kR_2)^2 + R_1^2$, $L_{(2,1)}^2 = (2R_1)^2 + R_2^2$	PLI "+1 Pythagoras" rule for perpendiculars avoids null channels; respects Janus symmetry [2].
Coupling dictionary	$\alpha_i = K\, m_i/L_i^2$; $\alpha_{\text{em}}^{-1} = \alpha_2^{-1} + \frac{5}{3}\alpha_1^{-1}$	One common scale K set by compactification (or fixed by a single coupling for presentation) [2].

Compact parameter figure (for slides)

Parameter	Final choice	Why (source)
Manifold & seam	$\mathbb{R}^{3,1} \times T^2 \times \mathbb{R}_{t_2}$; Janus at t_2=0	Minimal structure; reflection positivity; GR on slices [2].
Ghost protection	Local $\mathrm{Sp}(2, \mathbb{R})$; BRST cohomology	Removes extra-time ghosts; single massless spin-2 [2].
Constants	c, G fixed (no floats)	PLI forbids gratuitous functions; variable-c retired [1].
Hidden-time kernel	Radial, Gaussian-class (quadratic)	OS positivity; MDL favours Gaussian; I_3=0 [3, 11–13].
Compact space	Rectangular T^2	Simplest lattice with needed isometries [2].
Axis integer	k=3	Smallest winding consistent with EW mix [2].
Asymmetric pair	$(2, 1)$	Minimal colour loop for α_3 [2].
Multiplicities	m_x=m_y=2, $m_{(2,1)}$=4	Janus parity / sign reversal [2].
Radius ratio	R_2/R_1=$\sqrt{17/7}$	Fixes α_2/α_1=2 at M_Z [2].
Coupling map	$\alpha_i = K\, m_i/L_i^2$	One compactification scale K; EM mixing relation [2].

4 From hidden time to quantum mechanics (one paragraph)

On a polarization-invariant (t, τ) plane with a *radial* positive-definite kernel, OS reflection positivity defines a physical inner product on $\tau \geq 0$ [4,5]. A Hubbard–Stratonovich representation turns the Euclidean weight into a quasi-free environment [6, 7]. With a unitary dilation, Stinespring/Choi implies a CPTP reduced map [8, 9]. The decoherence functional is Hermitian, normalized, and *strongly positive*; hence $p(\alpha) = D[\alpha, \alpha]$ are bona fide probabilities, and Born statistics follow without an extra postulate. PLI selects Gaussian increments within the finite-variance class; entropic uncertainty yields a compression bound that reframes complementarity [3, 10–13].

5 The mid-band $1/r$ trans-brane influence: definition and justification

Spectral statement

Let Φ be the Newtonian potential obeying $\nabla^2\Phi = 4\pi G\rho$. In Fourier space, $\tilde{\Phi}(\mathbf{k}) = -4\pi G\,\tilde{\rho}(\mathbf{k})/k^2$ and $\tilde{\mathbf{g}}(\mathbf{k}) = i\mathbf{k}\,\tilde{\Phi}(\mathbf{k})$. The trans-brane influence is modeled by a *derivative-suppressed* spectral kernel $\mathcal{W}(k)$,

$$\tilde{\mathbf{g}}_{\text{eff}}(\mathbf{k}) \;=\; \mathcal{W}(k)\,\tilde{\mathbf{g}}(\mathbf{k}), \qquad \mathcal{W}(k) \to 1 \text{ for } k \ll k_- \text{ and } k \gg k_+, \qquad \mathcal{W}(k) \;\propto\; \frac{k_0}{k} \text{ for } k_- \lesssim k \lesssim k_+, \tag{1}$$

with $k_- \ll k_+$ set by compact/Janus data and k_0 a fixed scale. The Hankel transform yields an *acceleration* profile with a mid-band window

$$g_{\text{eff}}(r) \;\propto\; \frac{1}{r} \quad \text{for} \quad r_- \;\lesssim\; r \;\lesssim\; r_+, \tag{2}$$

while recovering GR ($g \propto 1/r^2$) for $r \ll r_-$ and $r \gg r_+$. This produces *flat rotation curves* and co-located lensing without touching solar-system or CMB scales [2, 14].

Why this form is PLI-minimal

Among spectral modifications that (i) leave the UV/IR Newtonian limits intact and (ii) induce a *single* mid-band change, a one-bump, derivative-suppressed filter is the shortest description: two cutoffs $\{k_-, k_+\}$ and a single slope parameter (e.g. a two-knot log-linear template) suffice. More complex shapes (multiple bumps, running indices, nonlocal floats) carry extra code length. Thus PLI selects the simplest filter achieving the needed phenomenology [2].

Trans-brane interpretation

Coupling through the Janus seam (mirror brane) dresses the 4D Green's function by $\mathcal{W}(k)$: low/high k modes remain localized (no leakage), while mid-band modes partially sample the twin sector. This realizes the window above and provides a geometric explanation for flattened galaxy curves consistent with lensing maps [2].

6 Why 7D—and why not 8D or larger

Why 7D (3+1 large, T^2 compact, one hidden time). (i) Two time directions are the maximum that can be consistently gauged away with a local $\mathrm{Sp}(2,\mathbb{R})$ phase-space symmetry, removing extra-time ghosts while preserving a positive-norm 4D sector [2]. (ii) A rectangular T^2 is the *smallest* compact factor whose isometries and discrete geodesics seed an $SU(3)\times SU(2)\times U(1)$

sector without continuous moduli, in the Kaluza–Klein spirit [15,16]. (iii) With PLI forbidding floats, the integer set $\{k, (2,1), m_i\}$ plus a single anisotropy R_2/R_1 reproduces $(\alpha_1, \alpha_2, \alpha_3)$ at M_Z to $\sim$2% RMS [2].

Why not 8D or larger. Adding a dimension forces at least one of: (a) an extra compact factor (T^3 or curved 2-manifold) with additional integers/moduli; (b) a third time beyond the $\mathrm{Sp}(2, \mathbb{R})$ remit; (c) more off-diagonal metric components (gauge fields) than required by the SM. Each path raises the MDL score (more inputs to specify) without improving fits achieved by the T^2 dictionary; in addition, higher-D reductions tend to reintroduce moduli/landscape freedom [17–19]. Under PLI, such models are *disfavored* relative to 7D.

7 Relation to the early variable-c ideas

The notebook chronicles a *discrete-halving* exploration for $c(t)$ (staircase behaviour near $\sim$1 s after the bang). This was a productive probe but was retired because PLI forbids gratuitous functional freedom for constants once empirical constraints are in place. The final model fixes c and G and explains quantum statistics and SM couplings without time-dependent floats [1,2].

8 Concluding remarks

The Janus–PLI framework emerged by *eliminating* unnecessary structure step by step, guided by an explicit information principle. The surviving parameters are discrete and few; quantum mechanics follows from hidden-time positivity; SM couplings descend from minimal T^2 data; and a single, PLI-minimal mid-band kernel accounts for galaxy-scale anomalies while preserving laboratory/cosmology tests. The 7D setup is therefore a *local minimum* of description length under the stated constraints.

Acknowledgements

This historical consolidation and parameter ledger are based on three source documents; section tags in the text refer back to those files [1–3].

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