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The Clock-Separation Theorem: Why the Selective Transient Field Requires Two Clocks

A structural theorem: a periodic internal phase and a globally oriented universal ordering cannot be the same mathematical object — the oscillatory STF amplitude cannot itself be the universal clock, and the framework's universal/local time distinction is forced, not posited

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Abstract

The Selective Transient Field (STF) framework distinguishes universal time — the globally shared ordering established by the universe's first closure — from the internal, cyclic temporal structure of local systems, and for the STF scalar itself from its Compton phase. This paper proves that the distinction is not an ontological preference but a mathematical necessity. The framework's current field-level formalism defines a clock vector as the normalized gradient of the STF scalar, $n^\mu = \nabla^\mu\varphi/\sqrt{2X}$, while its cosmological sector requires the same scalar to oscillate as dark matter, $\varphi \simeq A\cos(m_s t)$. Along the integral curves of any normalized-gradient clock the generating scalar is strictly monotone; a periodic scalar therefore cannot generate a global temporal ordering through its gradient. This was first read as a contradiction. It is a theorem — with a precisely bounded reach. What is proved is that a periodic real scalar cannot define a continuous global clock through its normalized gradient across its turning points, so the oscillatory amplitude φ cannot itself be the universal clock carrier; the obstruction forces a carrier distinct from the amplitude. Conditional on a global phase map $\Theta_s: U \to S^1$, an admissible real lift, and dynamical synchronization $\tilde{\Theta}_s = m_s T_U + \delta$, universal time $T_U \in \mathbb{R}$ may then be represented by the unwrapped phase and the scalar's internal phase $\Theta_s \in S^1$ by its cyclic projection — the covering map $\mathbb{R} \to S^1$, $T_U \mapsto e^{i m_s T_U}$, $T_U = (2\pi w + \Theta_s - \delta)/m_s$ — with universal time retaining the continuous ordering information, including the integer cycle count w that the wrapped phase erases. The turning points of the amplitude, where the naive clock is undefined, are shown to be diagnostic evidence for the two-level structure: $d\varphi/dT_U$ vanishes there while $d\Theta_s/dT_U = m_s$ never does, and in phase space $(\varphi, \pi_\varphi/m_s)$ moves smoothly on a circle in the fixed-amplitude limit. The theorem is stated in three layers — a fully proved gradient-clock obstruction, a clock-separation corollary conditional on universal ordering being represented by

a scalar (as the framework does), and a phase-lift completion conjecture whose global-lift hypothesis is topologically nontrivial. The amplitude φ is a local half-cycle chart of the clock — exactly $x = \cos\Theta$ on S^1 — not the global coordinate. We state the theorem, its covering-space form, the phase-space demonstration, its consequences for the field-level formalism (a forced choice among genuinely different completions of First Principles, not a notational repair), and one firewall: the $4\pi^2$ normalization of the activation threshold is the cup product of the retarded and advanced Green-function sectors on the Hopf torus, and is not obtained by multiplying internal and universal clock periods. The theorem supports the necessity of distinct temporal structures; the Hopf cup product remains the separate derivation of the constant.

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1. Two commitments and an apparent collision

The STF framework carries two commitments that were, until this analysis, stated in different papers and never confronted.

The first is field-level. First Principles defines the clock vector that orients the curvature-rate coupling as the normalized gradient of the scalar:

$$X \equiv -\tfrac{1}{2}\nabla_\alpha\phi\,\nabla^\alpha\phi, \qquad n^\mu \equiv \frac{\nabla^\mu\phi}{\sqrt{2X}}, \qquad n_\mu n^\mu = -1,$$

with $X > 0$ assumed for the backgrounds analysed there — FRW tracking and quasi-stationary near-zone solutions — and with the explicit remark that this construction "introduces no independent vector degree of freedom."

The second is cosmological. The dark-matter sector requires the same scalar to oscillate at its Compton frequency,

$$\phi(t) \simeq A(t)\cos(m_s t + \delta), \qquad T_s = \frac{2\pi\hbar}{m_s c^2} = 3.32\ \mathrm{yr},$$

with the oscillation-averaged equation of state $\langle w\rangle = 0$ supplying the pressureless dark-matter behaviour.

Set side by side, they collide. Along any integral curve of n^μ,

$$\frac{d\phi}{d\tau} = n^\mu\nabla_\mu\phi = \frac{\nabla_\mu\phi\,\nabla^\mu\phi}{\sqrt{2X}} = \frac{-2X}{\sqrt{2X}} = -\sqrt{2X} < 0.$$

Reversing the overall sign of n^μ turns "decreasing" into "increasing" and nothing else. So a scalar whose normalized gradient defines a continuous clock is *strictly monotone* along that clock. But the dark-matter solution is periodic: $\dot\varphi = 0$ twice per period, so $X = 0$ there, the vector $\nabla^\mu\varphi/\sqrt{2X}$ is undefined, and across each turning point its orientation reverses. On a homogeneous background the interaction reduces to $-a^3\gamma\,\varphi\,\mathrm{sgn}(\dot\varphi)\,\dot R$, whose sign flips twice every 3.32 years.

An external audit stated this as a no-go: "the same real scalar cannot be both an oscillating field and a global normalized-gradient clock." That statement is correct. What was wrong was the direction in which it was pointed.

2. What the framework already says about time

The collision is between a formula and a regime, not between two claims of the framework. First Principles' $X > 0$ assumption is stated *for the tracking regime*, and there it holds: the tracking solution $\varphi \simeq J/m_s^2$ is monotone whenever the source is. The oscillation belongs to a different regime. And the framework's ontology has, from Theory of Time onward, kept universal time and local time apart:

- Universal time is the globally shared temporal ordering that "switches on" via the gravitational activation threshold — the geometric now, active across the region of spacetime that has crossed it — and, once established at the universe's first closure, a persistent shared background.
- Local time is what a closed system generates for itself: "the experienced present of a bounded system," a local temporal loop that *references* the universal ordering without being it. The rock is "carried by universal time," "not locally creating its own now."

The clock collision, read against this ontology, is a mismatch of levels. The Lagrangian oriented the *universal* curvature derivative $n^\mu\nabla_\mu\mathcal{R}$ using the gradient of the *internal* oscillating field. Three distinct things had been written with one symbol:

$$\underbrace{T_U}_{\text{universalordering}} \quad\longrightarrow\quad \underbrace{\Theta_s = m_s T_U + \delta}_{\text{internal phase}} \quad\longrightarrow\quad \underbrace{\phi = A\cos\Theta_s}_{\text{observable amplitude}} .$$

The no-go is what happens when all three are collapsed into φ. That is not a failure of the ontology. It is the ontology, proved.

3. The theorem

Theorem (gradient-clock obstruction). Let q be a scalar on spacetime with timelike, nonvanishing gradient on a region U, and let $n^\mu_q = s\,\nabla^\mu q/\sqrt{(-\nabla q\cdot\nabla q)}$, $s \in \{-1,+1\}$, be the associated unit clock vector (s fixes the orientation; in the $(-{+}{+}{+})$ convention used throughout, $s = -1$ makes n^μ_q future-directed for a future-increasing q). Then along the integral curves of n^μ_q,

$$n_q^\mu \nabla_\mu q = -\,s\sqrt{-\nabla q\cdot\nabla q} \neq 0,$$

with a definite sign fixed by s, so q is strictly monotone on every integral curve. Consequently no periodic scalar can generate, through its normalized gradient, a continuous global temporal ordering on U.

That is the **gradient-clock obstruction theorem**, and it is fully proved. **Status: theorem.** It uses no dynamics — only the definition of a normalized-gradient clock. Applied to $q = \varphi$ with $\varphi = A\cos\Theta_s$ periodic, it says: the oscillatory STF amplitude cannot itself be the global clock carrier through $n^\mu_\varphi \propto \nabla^\mu\varphi$; at every homogeneous turning point $X_\varphi = 0$ its normalized gradient is undefined.

Two further statements are conditional, and the conditions must be stated.

Corollary (STF clock separation). *If* the framework represents universal ordering by a scalar time function T_U with timelike gradient — as Theory of Time does — then T_U must be distinct from the oscillatory amplitude φ; and since $\Theta_s \simeq m_s T_U + \delta \pmod{2\pi}$ is the definition of the internal phase, the internal clock and universal time are distinct-but-related objects. **Status: entailment**, given the framework's representation of universal time by a scalar. A continuous time *orientation* by itself supplies a timelike direction field, not a preferred scalar time function; the existence of such a function requires stronger causal assumptions (stable causality) and its selection more still. Within STF the condition is met by construction; outside it, the corollary is conditional.

Proposition (phase-lift completion) — conditional. If there is a global phase map $\Theta_s: U \to S^1$, if it admits a lift $\tilde{\Theta}_s: U \to \mathbb{R}$, and if $\tilde{\Theta}_s = m_s T_U + \delta$, then T_U supplies exactly the cycle count erased by the wrapped phase (§4). Each hypothesis is substantive: a global lift exists only when the induced class in $H^1(U,\mathbb{Z})$ vanishes — and nontrivial winding, which the framework's topological sector invokes, is precisely where a single-valued global unwrapped phase can be obstructed. Three constructions must therefore be kept apart: a lift *along one worldline* (always possible after fixing an initial cycle count); a *globally defined spacetime scalar* lift (topologically conditional); and a *boundary-defined ordering* (a different construction). **Status: conjecture as a completion of STF; theorem where its hypotheses hold.**

The content of these three layers is not that STF is inconsistent. It is that STF's two clocks are *forced* at the level the theorem reaches — the amplitude cannot be the universal clock — and that the framework's existing choice to represent universal ordering by a scalar makes the separation an entailment. What is *not* thereby proved is which of the admissible completions realizes T_U (§7).

4. The covering-space form

Introduce the winding integer w counting completed cycles (we write w rather than N to avoid collision with the clock vector N^μ). Then the wrapped internal phase and the unwrapped universal time are related by

$$T_U = \frac{2\pi w + \Theta_s - \delta}{m_s},$$

which is exactly the lift of the covering map

$$\mathbb{R}_U \longrightarrow S^1_I, \qquad T_U \longmapsto e^{i m_s T_U}.$$

Under the lift hypotheses, universal time is represented by the unwrapped phase and the scalar's internal phase is its cyclic projection. The two clocks measure different things: $\Theta_s \in S^1$ says *where in the current cycle* the field is; $T_U \in \mathbb{R}$ says *which cycle* is occurring and supplies the global ordering. Neither replaces the other. The internal clock supplies the within-cycle phase; universal time retains the continuous ordering information, including the integer cycle count w that the wrapped phase erases (subject to the lift conditions of §3). w alone is only the discrete cycle label; T_U carries both the cycle number and the phase.

This is a covering-space structure. It shares its circle–lift–winding mathematics with the framework's topological sector, whose Hopf torus T^2_γ is a lift-and-project object of the same kind — but the two are not thereby the same physical or topological object. Topological Closure V6.3 defines T^2_γ as the Hopf preimage of a loop in the local celestial sphere, its circles the Hopf-fibre direction and transport around the sky loop; they are not presently defined as the scalar's Compton phase and a universal cycle count. We therefore state the relation as a *proposed correspondence* requiring an explicit map, not an identity: the two-clock ontology, the Hopf-torus geometry, and the resolution of the clock collision may be one statement, and this paper conjectures that they are.

5. Why the turning points prove the distinction

At an amplitude turning point,

$$\frac{d\phi}{dT_U} = -Am_s \sin\Theta_s = 0, \qquad \text{but} \qquad \frac{d\Theta_s}{dT_U} = m_s \neq 0.$$

Nothing temporal stops or reverses. Only the projection $\varphi = A \cos \Theta_s$ momentarily stops changing. The earlier calculation $X_\varphi = 0$ does not show that STF's clock fails; it shows that the amplitude is not the global clock coordinate. It is the horizontal coordinate of uniform circular motion pausing at the edge of the circle while the point moves on smoothly around it.

In phase space this is explicit. With the velocity $v_\varphi \equiv \dot\varphi = -A\, m_s \sin \Theta_s$ (we use the velocity, not the canonical momentum; in FLRW the canonical momentum density is $a^3\dot\varphi$),

$$\phi = A\cos\Theta_s, \qquad \frac{v_\phi}{m_s} = -A\sin\Theta_s, \qquad \phi^2 + \left(\frac{v_\phi}{m_s}\right)^2 = A^2,$$

so in the fixed-amplitude limit the pair $(\varphi, v_\varphi/m_s)$ moves on a circle of radius A and its S^1-valued phase $\Theta_s = \mathrm{atan2}(-v_\varphi/(Am_s), \varphi/A)$ is well defined everywhere away from zero amplitude, turning points included. Two qualifications: with $A = A(t)$ redshifting, $\dot\varphi = \dot A \cos \Theta_s - A\dot\Theta_s \sin \Theta_s$, so the identity holds in the WKB regime $|\dot A|/(m_s A) \ll 1$, $\dot\Theta_s = m_s + O(H/m_s)$, and the actual cosmological trajectory is a slowly contracting spiral rather than an exact circle; and atan2 yields a well-defined S^1-valued phase, not by itself a globally single-valued real phase — the lift is the separate step of §3. The apparent singularity arises only after discarding the conjugate momentum and attempting to use the one-dimensional projection φ as the entire clock. A given value of φ occurs at two phases per cycle — $\varphi = A/2$ at $\Theta_s = \pi/3$ and at $5\pi/3$ — so the phase is not a function of the amplitude alone; it requires field *and* momentum, or an independent phase variable. That is additional phase-space information, but not another propagating particle.

So the turning point is diagnostic evidence for the two-level structure — it proves the failure of φ as the clock coordinate; it does not by itself select the phase-lift completion over a khronon, a vector, a foliation, or a boundary-defined ordering:

$$\text{phase-space motion} \;\longrightarrow\; \text{internal cyclic reading} \;\longrightarrow\; \text{universal winding order.}$$

6. Reinterpreting the normalized-gradient formula

The First Principles expression $n^\mu_\varphi = \nabla^\mu\varphi/\sqrt{2X_\varphi}$ can serve only as a *local clock chart* on a monotonic half-cycle. It cannot be the global definition across the complete oscillation. This is exactly the status of $x = \cos \Theta$ as a coordinate on S^1: it works locally; it fails at the two turning points; two different phases share each value of x; and a second chart, a phase-space coordinate, or the unwrapped phase restores the global description.

The globally valid clock vector should therefore be written from universal time,

$$N^\mu = -\frac{\nabla^\mu T_U}{\sqrt{-\nabla T_U \cdot \nabla T_U}}, \qquad N^\mu \nabla_\mu T_U > 0,$$

or equivalently, wherever an unwrapped phase exists,

$$N^{\mu} = -\frac{\nabla^{\mu}\tilde{\Theta}_s}{\sqrt{-\nabla\tilde{\Theta}_s \cdot \nabla\tilde{\Theta}_s}}, \qquad \tilde{\Theta}_s = m_s T_U + \delta \in \mathbb{R},$$

with the curvature-rate interaction $L_{int} = \gamma\, \varphi\, N^\mu \nabla_\mu \mathcal{R}$. Then T_U is monotone; N^μ never depends on whether $\dot{\varphi} = 0$; Θ_s is the continuously advancing internal phase; and $\varphi = A \cos \Theta_s$ may oscillate and reverse direction without universal time reversing. The tracking-regime clock n^μ_φ remains correct where First Principles uses it, as the local chart it always was.

This need not introduce another propagating field. The universal clock may be the global lift or a boundary-defined ordering, while the internal phase is encoded in the scalar’s existing phase space. What the formalism must do — and this is the choice the theorem forces on First Principles — is *specify* mathematically what carries universal time: a universal clock scalar T_U, a globally selected timelike congruence N^μ, a boundary-defined foliation, or the unwrapped STF phase; and then use that choice consistently in the action and its variation. This is not a notational change. Replacing n^μ_φ by N^μ inside the action is dynamically substantive: it changes the scalar Euler–Lagrange equation, the metric variation and stress tensor, the number and type of background structures, the constraint algebra, the Horndeski/DHOST classification, and the preferred-foliation and perturbation analysis. The theorem forces a choice among genuinely different completions — an independent khronon/time scalar; a constrained timelike vector or foliation; a complex or rotating scalar with a genuine phase degree of freedom; a boundary-defined nonlocal ordering; or restricting the present EFT to $X > 0$ and abandoning its use in the oscillatory regime — each with its own degrees of freedom and stability conditions. The remark that the construction “introduces no independent vector degree of freedom” remains correct for the dependent vector $n^\mu_\varphi[\varphi]$ used in the tracking regime — the problem is that this dependent vector becomes undefined in the oscillatory regime — but it cannot automatically be carried over to a completion with an independent clock carrier, which may introduce new background structure or new propagating degrees of freedom depending on the choice. Both amendments have been made to the canonical First Principles V7.9 (June 2026 revision), which deploys with this paper. To be exact about what that revision does and does not do: it scopes the $X > 0$ assumption to the tracking regime, names the unwrapped phase as the carrier of the ordering in the oscillatory regime, states that $n^\mu_\varphi \propto \nabla^\mu\varphi$ is a local half-cycle chart there, and revises the vector-degree-of-freedom remark as above; it does *not* choose a completion, vary a replacement carrier, or update the stress tensor and constraint analysis — its working equations remain those of the fixed-clock theory (its Appendix G), and it says so. The completion is the open item of §7, not a claim of this paper.

7. Where the phase clock stands, and what it costs

Of the available carriers, the unwrapped phase is the most natively STF candidate, and may correspond to one component of the framework’s T^2 winding structure — but the required map has not been constructed (§4). Its gradient is defined at every point along an idealized oscillator trajectory; as a spacetime field the phase may fail to admit a global lift, may have zeros or defects, may develop a null or spacelike gradient, and fails where the oscillation amplitude vanishes — obligations of the completion, not of the theorem. Two further costs are recorded honestly.

First, the phase carries information the real amplitude alone does not (Section 5); whether it is realised as the phase of a complex field, as a phase-space coordinate, or as a boundary lift is a formulation choice with different consequences for the degree-of-freedom count, and the single-field Horndeski/DHOST analysis does not automatically transfer to a two-variable clock. That analysis is open.

Second, for a redshifting clock the normalized-vector perturbations carry coefficients $\propto 1/|\dot\Theta|$; for a shift-symmetric phase with $\dot\Theta \propto 1/(a^3F)$ this becomes strongly coupled toward the de Sitter future. A rotating field with $\dot\Theta \simeq m_s$ avoids the vanishing rate, at the price that its phase-kinetic coefficient redshifts instead. Neither is a defect of the theorem; both are obligations of whichever completion is adopted, and are recorded as such.

8. The $4\pi^2$ firewall

One precision matters. STF's activation threshold carries the factor $4\pi^2$:

$$\mathcal{D}_{\rm crit} = \frac{m_s\, M_{\rm Pl}\, H_0}{4\pi^2}.$$

It would be natural — and wrong — to read the present theorem as deriving $4\pi^2$ from the product of an internal and a universal clock period. First Principles derives $4\pi^2$ as the *cup product of the retarded and advanced Green-function sectors* on the Hopf torus, and Topological Closure V6.3 establishes it as $\int_{T^2_\gamma} \omega_R \wedge \omega_A = 4\pi^2$ by Heegaard transgression. The two genuinely independent factors are the conjugate Green-function sectors — retarded × advanced — not internal × universal time. The clock-separation theorem supports the necessity of distinct temporal structures; the Hopf cup product remains the separate, and prior, derivation of the constant. The two results are consistent and independent, and this paper claims only the first.

9. Scope and empirical discriminants

The theorem is a mathematical statement and is not falsifiable by observation; what is testable is the framework's use of it. Two items are recorded (an earlier first item merely restated the theorem's hypotheses and has been removed):

1. The claim that the amplitude turning points are non-events for universal time predicts no observable discontinuity in curvature-rate response at the STF half-period. A detected sign-flip of STF response locked to the 1.66-year half-cycle would indicate that the amplitude, not the phase, orients the coupling — and would reopen the collision.
2. *(Withdrawn on review.)* An earlier draft proposed that STF-mediated effects should depend on the absolute winding count through T_U. That does not follow from the repaired action, whose interaction contains $N^\mu \propto \nabla T_U$ and is invariant under $T_U \mapsto T_U + \text{const}$; the action predicts dependence on the local clock direction, not on an absolute cycle number. A cycle-count dependence would require a separate w-dependent operator, which the framework does not currently contain.

10. Conclusion

A result that entered as a no-go leaves as a derivation. Given a periodic internal phase and a globally oriented causal ordering — both of which the framework holds — the internal clock and universal time cannot be the same mathematical object. The obstruction forces a carrier distinct from the oscillatory amplitude; conditional on a global phase lift and dynamical synchronization, universal time may be represented by the unwrapped phase while the scalar’s internal phase is its cyclic projection — the cycle count being what the wrapped phase forgets and the universal ordering retains. The turning points that looked like a wound are the fingerprints of the two-level structure. What the theorem imposes on the formalism is exact but not small: name the carrier of universal time, and carry that choice through the action, its variation, and its stability analysis — a completion, not a relabelling. What it gives the framework is larger: its oldest ontological distinction, stated in Theory of Time as a claim about experience, is now a theorem about clocks.

Appendix A — Derivation record

The chain of external derivations from which this paper’s theorem was extracted, in the order they were produced, each with its independent verification status. This appendix is the primary derivation; the verbatim audit documents (`STF_Audit_Record_2026-06-14_Part1.md`, D1, D3, D4) and the verification log (`AUDIT_VERIFICATION_LOG_2026-06-14.md`) are supplementary provenance, to be published alongside the paper. Status labels: ***verified*** *= reproduced symbolically from the corpus’s own definitions;* ***corpus-verified*** *= the cited framework statement was checked verbatim against the deployed paper.*

A.1 The no-go as first stated (D1 §7 and continuation)

Definitions (First Principles): $X = -\tfrac{1}{2}\nabla_\mu\varphi\nabla^\mu\varphi$, $n^\mu = \nabla^\mu\varphi/\sqrt{2X}$, $n_\mu n^\mu = -1$, with $X > 0$ assumed for FRW tracking and near-zone backgrounds. Cosmological sector (Dark Matter as Geometry): $\varphi \simeq A(t)\cos(m_s t + \delta)$, period 3.32 yr, $\langle w\rangle = 0$.

Along an integral curve of n^μ: $d\varphi/d\tau = n^\mu\nabla_\mu\varphi = (\nabla\varphi\cdot\nabla\varphi)/\sqrt{2X} = (-2X)/\sqrt{2X} = -\sqrt{2X} < 0$. Reversing the sign of n^μ turns “decreasing” into “increasing” only. Hence a normalized-gradient clock forces its generating scalar to be strictly monotone; a periodic scalar cannot generate one. At each turning point $\dot\varphi = 0$, $X = \tfrac{1}{2}\varphi^2 = 0$, n^μ undefined; across it, orientation reverses. On homogeneous FLRW the interaction reduces to $-a^3\gamma\varphi\,\mathrm{sgn}(\dot\varphi)\dot{R}$, non-differentiable at every turning point; varying it produces $d/d\dot\varphi\,\mathrm{sgn}(\dot\varphi) = 2\delta(\dot\varphi)$, i.e. distributional terms with no smooth continuation across $X = 0$. **[verified: monotonicity, X = 0 at turning points, sign-flip of the coupling; corpus-verified: FP 376–379, DM 142.]**

Two variational paths (D1 continuation): (A) vary $n(\varphi)$ — the self-referential theory, singular at $X = 0$; (B) hold $n^\mu = u^\mu_{FLRW}$ fixed — regular and linear, $\ddot\varphi + 3H\dot\varphi + m_s^2\varphi = -\gamma\dot{R}$, but not the Euler–Lagrange equation of the stated action (First Principles Appendix G concedes the working equation “treats n^μ as independent of φ in the variation”). **[corpus-verified: FP 4710.]**

The full variation with $h^{\mu\nu} = g^{\mu\nu} + n^{\mu n}\nu$, $\delta n^\mu = (1/\sqrt{2X})h^{\mu\nu}\nabla_\nu\delta\varphi$, gives $\Box\varphi - m_s^2\varphi + \gamma[n^\mu C_\mu - \nabla_\nu((\varphi/\sqrt{2X})h^{\mu\nu}C_\mu)] = 0$, $C_\mu = \nabla_\mu\mathcal{R}$; on FLRW away from turning points $n^0 = -\mathrm{sgn}(\dot\varphi)$, $h^{\mu\nu}\nabla_\mu\mathcal{R} = 0$, so the projected term vanishes piecewise while the Lagrangian remains non-differentiable at $\dot\varphi = 0$. **[verified in structure.]**

A.2 Stress test: the regimes (this paper’s verification)

FP’s $X > 0$ assumption is stated for FRW tracking, where $\varphi \simeq J/m_s^2$ is monotone whenever the source is: the assumption is *true for its regime*. The oscillation belongs to a different regime. The collision is therefore a scope collision between two regimes claimed for one field, not a computational error in either paper. **[verified.]**

A.3 The two-clock reading (D3)

Universal time = the globally shared ordering established by the universe's first closure; internal time = a system's cyclic/local structure, for the STF field its Compton phase Θ, $d\Theta/dT \simeq m_s$. Corpus: Theory of Time 1184–1186 (universal time "switches on" via the gravitational threshold, distinct from "the experienced present of a bounded system"); General Theory 1517/1732 (rock "carried by universal time," "not locally creating its own now"). The no-go is a *level mismatch*: the Lagrangian oriented the universal curvature derivative with the internal field's gradient — collapsing $T_U \to \Theta = m_s T_U + \delta \to \varphi = A\cos\Theta$ into φ. With a universal clock $T_U(x)$, $N^\mu = -\nabla^\mu T_U/\sqrt{(-\nabla T_U\cdot\nabla T_U)}$, $N^\mu\nabla_\mu T_U > 0$, and $L_{int} = \gamma\varphi N^\mu\nabla_\mu\mathcal{R}$: T_U monotone; N^μ independent of $\dot\varphi = 0$; φ oscillates without universal time reversing. A phase alone at a turning point is not determined by the amplitude (same φ on ascending and descending arcs) — field and momentum, or an independent phase variable, are needed. FP 381's "no independent vector degree of freedom" cannot stand as written; the ordering is carried by the phase / global lift. **[corpus-verified: ToT 1184–1186, GT 1517/1732, FP 381; verified: phase not a function of amplitude, $\varphi = A/2$ at $\Theta = \pi/3$ and $5\pi/3$.]**

A.4 The theorem pointed the right way (D4)

For any q with $n^\mu_q = s\nabla^\mu q/\sqrt{(-\nabla q\cdot\nabla q)}$, $s = \pm1$: $n_q\cdot\nabla q = -s\sqrt{(-\nabla q\cdot\nabla q)} \neq 0$ with definite sign $\Rightarrow$ q monotone, not periodic. STF's $\varphi = A\cos\Theta_s$, $\Theta_s \simeq m_s T_U + \delta$, is periodic $\Rightarrow$ φ is not universal time $\Rightarrow$ internal clock $\neq$ universal clock — deduced, not posited. Covering-space form: $T_U = (2\pi w + \Theta_s - \delta)/m_s$; $\mathbb{R}_U \to S^1_I$, $T_U \mapsto e^{i m_s T_U}$; universal = unwrapped lift, internal = cyclic projection; N = the information the periodic reading erases. Turning points: $d\varphi/dT_U = -A m_s \sin\Theta_s = 0$ while $d\Theta_s/dT_U = m_s \neq 0$; phase space $(\varphi, \pi_\varphi/m_s) = (A\cos\Theta_s, -A\sin\Theta_s)$ circles at radius A with single-valued phase everywhere; $X_\varphi = 0$ is the amplitude being a local half-cycle chart ($x = \cos\Theta$ on S^1), not a clock singularity. Globally valid clock: N^μ from T_U or the unwrapped $\tilde\Theta_I = m_s T_U + \delta \in \mathbb{R}$. **[verified: covering-space lift reproduces T_U exactly for correct N; $d\Theta_s/dT_U = m_s$ never zero; $\varphi^2 + (\pi_\varphi/m_s)^2 = A^2$; atan2 recovers phase; $x = \cos\Theta$ chart fails at two points.]**

A.5 The $4\pi^2$ firewall (D4, closing precision)

STF's $4\pi^2$ is derived from the independent retarded and advanced Green-function classes — the Hopf cup product (First Principles §4194ff.; Topological Closure §3.4, $\int\omega_R\wedge\omega_A = 4\pi^2$ by Heegaard transgression) — not by multiplying internal and universal clock periods. **[corpus-verified: FP 4194/4208 — the two factors are "the conjugate Green-function sectors," explicitly "not time vs space."]**

A.6 What the chain established, in one line

Contradiction (A.1) → scope collision (A.2) → level mismatch (A.3) → theorem (A.4): each pass smaller and more precisely located; the last derives that the amplitude cannot be the universal clock and — conditional on the lift hypotheses — that the two-clock ontology is realized by an unwrapped phase whose correspondence to the T^2 winding remains a conjecture, with $4\pi^2$ untouched (A.5).

References

Project papers (existshappens.com):

- *STF First Principles* V7.9 — papers/first-principles/ (clock vector definition; $X > 0$ scope; Appendix C scope; Appendix G variation note; the $4\pi^2$ cup-product derivation, §4194ff.).
- *Dark Matter as Geometry* — papers/dark-matter/ (the cosmological oscillation $\varphi \simeq A \cos(m_s t)$, $\langle w \rangle = 0$).
- *Theory of Time* V4.3 — papers/theory-of-time/ (universal time via the gravitational threshold; local temporal loops referencing an existing universal time).
- *The Structure of What Happens* (General Theory) V3.1 — papers/general-theory/ (four-state ontology; State 1 "carried by universal time"; State 3 forward + backward arc).
- *Topological Closure on the Complexified Null Cone* V6.3 — papers/topological-closure/ ($\int \omega_R \wedge \omega_A = 4\pi^2$ by Heegaard transgression; Hopf/anti-Hopf sectors).
- *Temporal Workspace* — papers/temporal-workspace/ (the 3.32-yr rung as coherence horizon).
- *The Closure–Capacity Correspondence* V1.0 — papers/closure-capacity/ (cycle time vs backward reach).

External:

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