

The Topological Tripwire

An independent research deposit

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AI assistance disclosed: This work was developed in extended collaboration with Claude (Anthropic), used as a reasoning partner, calculation engine, and drafting aid. All research decisions, physical interpretations, and final judgments are the author's own; all results were verified against primary data and source records. The author is solely responsible for the content, including any errors.

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A theory of verification: detect by the integer noise can't fake, gate the expensive channel with the cheap one, read the committee through coherence, the linking through framing, and audit the books across viewpoints — with worked examples on the Riemann critical line and pose-angle arrays.

Working paper, v4.3 (deposit candidate) — July 2026. v4.1 completed the coordinate-free channel stack and corrected its June lineage. v4.2 added the geodetic instrument's external validation: the loop/pair channels are tested against real GNSS deformation (Nevada Geodetic Lab daily solutions; Blewitt, Hammond & Kreemer 2018, Eos) and validated against an independent physical instrument — the USGS Parkfield creepmeter array — by two methods, plus a campaign that reproduces the known ETS deformation signal on an external tremor clock. v5 opens the stellar spoke (asteroseismic first light on two Kepler targets). Framing law (SC-11): natural substrates carry no adversary; every anomaly here is treated as a confession by our instrument or our anchor until proven otherwise. Novelty stance unchanged: no new mechanism is claimed. v4.3 is the literature-pass edit (pass run 2026-07-09; citations verified from primary at W1): the verdict is that every wire in this paper is prior art — the win condition for a synthesis paper — and the candidate contribution relocates, cleanly, to the assembly plus the external validation. No result changed in this edit; every change is a reword, a citation insert, or a framing correction. Honest failures remain in the text by policy. All results reproducible from session logs (July 8-9 2026). Scope of this edit: geodetic (v4.2) + coordinate-free theory only; the star section (v5) owes its own literature pass and its numbers are untouched here. Both citation-pass deposit-diligence notes are now resolved (US 10,333,958 assignee confirmed Cisco from USPTO primary; self-fit pole comparison resolved against ITRF2014-PMM / Altamimi et al. 2017 at 2.1%, replacing the earlier prose 3% against a recalled value — the claim strengthened under audit).

DEPOSIT DILIGENCE — TWO OPEN NOTES, RESOLVE BEFORE SUBMISSION (logged here so they cannot be missed): 1. **US 10,333,958** (persistence-diagram / bottleneck-distance anomaly detection, cited in "Prior art and positioning"): reconfirm the assignee/inventor line from the USPTO record. The substance is verified; the attribution line is the open item. *(Both deposit-diligence notes from the citation pass are now RESOLVED and folded into the text: US 10,333,958 assignee confirmed as Cisco*

Thesis in one breath

Some numbers wobble and some numbers tick. Amplitudes, phases, energies, and positions are continuous: noise smears them, adversaries nudge them. Winding numbers, wrapping degrees, sign-change counts, framing twists, and linking numbers are integers: they cannot move by less than one, so noise — which can only wiggle — cannot move them, within their binning scale. A detector built on ticking numbers is deaf to noise by construction. The Topological Tripwire wires cheap integer channels that watch forever, gating expensive continuous channels that wake only where an integer says something happened, with a coherence channel for distributed agreement no single sensor can see. Version 4 completes the homotopy stack: the loop reports not one integer but a ladder of them — its winding (π_1), the wrapping of the field it encloses (π_2), the self-twist of its framing (writhe/twist), and the linking of the field lines through it (π_3 /helicity) — and each rung catches structure the others are provably blind to.

Part I — The idea, plainly

It is pouring rain at night. The rain is boring — even, statistically identical — and boring is a superpower, because boring can be measured exactly. Someone invisible crosses the yard; where they stand the rain stops landing. You never see the person, only the hole they cut in something even. Detection by invariant-breaking: don't look for the thing, look for the dent it makes in books you already know how to balance. Then economize — a cheap guard watches the tick forever, an expensive expert sleeps until the guard shouts. That economy is not this paper's invention: it is the operating principle of quantum-error-correction syndrome decoding, where a cheap parity check runs continuously and the expensive decoder stays inactive on a null syndrome (US 9,748,976, Northrop Grumman 2017, Bacon-Shor). This paper's move is to port that economy off designed quantum codes onto natural conserved-quantity fields. Then federate — some quarry touches no sensor hard enough to tick, yet leans on every sensor faintly and in phase; for that, read the array's resultant. Then climb — some structure lives not in how the field circulates but in how it links through itself; for that, read the framing and the helicity. Guessing is cheap, checking is cheap, agreeing is cheap to verify; solving from scratch is brutal. The architecture lives in those gaps.

Part II — The spine

The five channels. 1. *Integer channel* (π_1): winding/sign-count/event-count — quantized, noise-immune within its binning scale, cheap, coarse. 2. *Continuous channel*: amplitude, energy, likelihood — informative, expensive, corruptible; resolves grazes and identities. 3. *Coherence channel*: resultant $|R|$ across many sensors — detects distributed agreement invisible per-sensor; specific to coherence, not energy. 4. *Twist channel* (framing / writhe-twist): the self-rotation of a framed loop's ribbon — detects helical field structure the flat loop's circulation cannot see; its sign is chirality. 5. *Linking channel* (π_3 / helicity): $\langle \text{field} \cdot \text{curl field} \rangle$, the linking of field lines through the loop — detects linking that circulation, wrapping, and even twist leave unchanged.

Design rule: the integer gates where the continuous is measured; the coherence watches for what no gate trips on; the twist and linking read the handedness and knotting the lower rungs are structurally blind to.

Provenance of the design rule (relocated at the literature pass, and better for it). The cheap-guard-gates-expensive-expert economy is the operating principle of QEC syndrome decoding: a continuously running, low-cost syndrome/parity measurement gates an expensive decoder that acts only on a non-zero syndrome — patented in exactly this null-gated form (US 9,748,976, Northrop Grumman, granted 2017; Bacon-Shor code; a null syndrome leaves the decoder logic fully inactive). What this paper does is PORT that economy off designed quantum codes — where the conserved quantity is engineered into the stabilizers — onto natural conserved-quantity fields, where the integers (winding, wrapping, framing, linking) are supplied by the physics rather than by the code designer, and then validate the port against an independent physical instrument. The gate economy is adjacent art applied in a new place [ADJ], not a new mechanism [NEW].

The matched-filter law (spine, confirmed thrice). Every topological/loop channel is operationally a derivative operator: it differences the field around a circuit. Derivatives annihilate smooth systematics exactly (curl of a gradient is zero; the loop sum of a scalar telescopes) and amplify white noise mercilessly (differencing compounds independent variance). Therefore a topological channel without a pre-filter matched to the target's correlation scale is not partial but broken. Confirmed in three unrelated instruments this session: the π_2 noise cliff, the pose-angle circulation, and (implicitly) the π_3 helicity readout, which requires the same coarse-graining to survive per-cell noise.

The projection law (v4.1, representation-space twin of the matched-filter law). For a planar (abelian) seam, every faithful representation of the junction pose — $U(1)$ phase, $SO(2)$, $SO(3)$ about a fixed axis, quaternion, Euler real-triple — is provably identical: single-axis transports commute, so all styles compute the same sum (verified to ten decimal places at zero noise; bit-identical ternary survival at every noise level). The style question acquires content only where transports fail to commute. There, the planar $U(1)$ projection of a non-abelian holonomy carries a *systematic* bias — the Baker–Campbell–Hausdorff correction terms — that no pre-filter can remove: the ternary read dies at zero noise once out-of-plane content exceeds ~ 0.3 rad rms (survival 52% at 0.6 rad rms), while the full pose read is exact by construction. Two admission prices, one lesson: the matched-filter law prices the noise; the projection law prices the commutativity. Both must be paid before any loop channel is trusted. Corollary of record: Euler real-triple storage degrades as $\sim 1/\cos(\text{pitch})$ near the gimbal pose (2×10^{-9} within 10^{-8} rad of the pole) while the quaternion pipeline holds flat at 2×10^{-14} everywhere — for steep poses, quaternions are mandatory.

The ledger. Local integers reconcile globally: sums of indices over closed manifolds equal characteristic classes (Poincaré–Hopf, Gauss–Bonnet, Descartes' 4π deficit budget). A total conserved while the distribution misbehaves (a 0 beside a 2 where 1-and-1 was expected) is a bookkeeping anomaly — and that signature is itself a detection.

Event time. Normalize change-energy per event, not per clock-tick: noise accumulates every tick, signal makes events. Event cameras, econometric bipower variation, and spectral unfolding are one reparametrization in three fields. The econometric cousin is cited as ancestry, not analogy: bipower variation and jump detection (Barndorff-Nielsen & Shephard; Lee & Mykland) separate the jump component from the diffusion component of a noisy series by exactly this move, and SC-1's event-gated energy estimator is that machinery transferred to geodesy with the event channel supplied by an external instrument.

Known blind spots (theorems, not bugs). Net-charge-zero targets: invisible per-rung. Distributed sub-threshold targets: invisible per-sensor (fixed by coherence). Scalar observables: loop-blind by the telescoping identity. Helical structure at fixed circulation: invisible to π_1 (fixed by twist/ π_3). Each fix has a price: climb a homotopy rung, add a channel, or promote the observable from scalar to vector.

Part III — The record (all results reproducible from session logs, July 8 2026)

Coherence channel — PASSED, both legs. $N=900$ sensors, complex noise $\sigma=1$, distributed phantom per-sensor SNR 0.15 (invisible individually), 4000 trials, FA 1%. Coherent resultant detected 100.0% (7.9σ); best single sensor 1.5% (chance); incoherent energy sum 4.4% (0.67σ , blind). Phase-scrambled imposter of identical power fired the coherent channel at 1.1% — its false-alarm floor. Detects agreement, not energy. Prior art: beamforming / phase-coherent stacking.

Twist channel (framed loop) — PASSED, non-redundant. Case A (in-plane field, no helicity): circulation 1.00, twist 0.00 ± 0.05 . Case B (helical field added, identical in-plane curl): circulation unchanged at 0.99, twist lit to 1.00 ± 0.04 . Separation A vs B: circulation 0.15σ (blind), twist 15.5σ . Chirality: left-helical twist +1.0, right-helical -1.0 — sign is handedness. This is the Călugăreanu writhe/twist split made operational; the flat loop discards the twist component.

Linking channel (π_3 / Hopf) — PASSED, isolated. Holding circulation (π_1) and wrapping (π_2) fixed and varying only field-line linking, the Hopf readout $\langle \mathbf{n} \cdot \text{curl } \mathbf{n} \rangle$ moved monotonically (0.00, -0.064, -0.124, -0.176) while circulation stayed pinned at 1.96 and wrapping at 0.78. A degree of freedom exists — linking/helicity — that the lower rungs are structurally blind to. Physical identity: magnetic helicity, the conserved winding whose near-conservation under reconnection makes it a protected ledger column.

π_2 wrapping detector — naive claim FALSIFIED, repaired by the matched-filter law. Degree-1 hedgehog on a triangulated sphere, per-vertex vector noise. $\sigma=0.3$: degree 25/25 while continuous fidelity already -9%. $\sigma=0.6$: raw degree collapses to 8% correct while the continuous channel stays readable (0.70) — white noise manufactures spurious wrappings and the integer dies *before* the amplitude. Repair: pre-smooth to the texture scale — two passes restore 100% at $\sigma=0.6$, 88% at $\sigma=0.9$.

Pose-angle arrays — scalar/vector split, pre-registered. Scalar: loop residual telescopes to machine epsilon — no information, permanently. Vector: loop circulation annihilates gradient systematics exactly (a contaminant carrying 99.7% of power leaked zero) and, pre-filtered, recovered $r=0.23\pm 0.10$ with a 0.3%-power curl signal where naive analysis read -0.01 ± 0.03 . This is the astrometric E/B decomposition; the loop channel's license is the vectorial observable — pose carries the load.

Byzantine vs anomaly — PASSED. A real (smooth) field anomaly reconciles around loops (inconsistency 0.21); four compromised sensors break reconciliation (1.21), a $5.7\times$ separation. The array distinguishes mutiny from discovery by loop consistency.

Influencer fingerprint + bearing — demonstrated. Divergence, curl, and quadrupole channels sort particle (flux 1.0, curl ~ 0), wave (curl 0.53, flux ~ 0), and field (quadrupole-dominant); the net-vector bearing recovers the influencer's direction.

Prior record (retained): winding beats amplitude ~ 8 dB at fixed FA; value-of-information scheduling cuts measurements 2–4 $\times$; MWPM decoder reproduces the toric-code threshold ($\sim 10.3\%$, literature-validated); global net-charge refuted as a detector; net-zero targets structurally invisible per-rung; statistical precursors demoted to resilience meters at their Cramér–Rao floors.

Part IV — Sky sampling (question settled June, numbers measured July)

For full-sphere arrays, dodecahedral (icosahedral-vertex) sampling is adopted as default over lat-long grids. The D12-vs-D20 question was posed and settled in the June corpus (Appendix X addendum); the July session measured the numbers: 1.27 $\times$ tighter worst-case gap and 1.2 $\times$ better coverage uniformity across twelve patches, with no pole bunching. This is standard spherical-tessellation practice (HEALPix, geodesic arrays); adopted as a design default, not claimed as novel. The twelve faces close the full 4π solid angle — and Descartes' theorem guarantees exactly twelve pentagons on any such closed cage, tying the sampling geometry to the ledger's curvature budget.

Part V — Worked example I: the critical line (retained)

Gram-point sign check = integer guard; Turing's method = ledger audit; Riemann–Siegel = expert. Executed July 2026 (mpmath, 25-digit): guard 125/125 vs true count; first Gram-law violation caught at $n=126$ with the ledger-conserving 1,0,2,1,1 signature ($n=134$ flagged unprompted); Lehmer pair #6709–6710 resolved (gap 0.0377 = 4.2% of mean spacing; graze $\max|Z| = 0.003967$ vs typical ~ 1.0) — invisible to the sign guard alone (two crossings restore the sign; a net-zero target on live data), resolved only by fusion. Supplementary: spacings of zeros #1–1000 reject Poisson (0/999 gaps below 0.1 vs 9.5% expected), match GUE; number variance saturates at ~ 0.30 below GUE log-growth — Berry's saturation set by the prime 2, the octave capping the tower.

Part VI — Worked example II: the pose-angle array (retained, v3)

A star/pulsar array in the tripwire idiom: calibrated wells as knowns; heterogeneous per-station observables weighted by what each provides; template banks for known quarry, coherence for unknown agreement; discrimination by the multipole ladder — monopole = clock, dipole = observer (removable), signal begins at quadrupole because energy and momentum conservation forbid monopole and dipole gravitational radiation. The loop-walk formalism applies iff the observable is vectorial; its payoff is exact annihilation of gradient systematics. The architecture, specified independently, converged on the operating structure of pulsar-timing / astrometric GW detection; reported as calibration, not priority.

Part VII — Honest limits and open frontier

Structural: net-zero targets invisible per-rung; scalar observables loop-blind by identity; every topological channel pays the matched-filter tax or fails (thrice shown); the continuous channel is as corruptible here as anywhere; the coherence channel is blind to incoherent quarry by design. Informational: precursor floors are Cramér–Rao bounds. Domain: the architecture presumes a statistically even background; where the rain is structured, the ledger must first learn the rain. Cosmological aside (fenced): a closed-universe antipodal collector for the ledger's records exists iff dark energy is not eternally constant — a conditional, not a claim. The literature

pass on the wiring claim has now run (2026-07-09; see "Prior art and positioning"): every mechanism is confirmed prior art — topology as trigger, coherence as committee, twist/linking as handedness channels, matched filtering as admission price, the gate economy itself (QEC syndrome decoding) — and the candidate contribution is the assembly plus the external validation. The assembly claim itself remains PROVISIONAL: we found no prior assembly in a bounded adversarial search, which is not the same as none existing; the persistent-homology anomaly-detection neighborhood is large and fast-moving, and this is the paper's most exposed claim. Also open: the joint detection-estimation bound, and the deliberately fenced curvature-to-zeta-zero seam, which remains Hilbert–Pólya's, not ours.

Part VIII — EXTERNAL VALIDATION OF THE GEODETIC INSTRUMENT (v4.2 spine)

VIII.0 The validation standard, stated before the results

An instrument that has only ever agreed with itself has not yet been tested. Through v4.1 every channel in this program was kill-tested internally: nulls, injections, shuffles, held-out floors. What v4.1 did not have was an *external witness* — an independent physical instrument, with independent failure modes, recording the same patch of Earth. Version 4.2 exists because the program now has two such meetings, and the standing concept that demanded them (SC-7: the only defense against correlated drift is a reference with orthogonal failure modes) is hereby promoted from principle to enacted result. A GPS differential pair is satellite geodesy: its failure modes are orbits, antennas, troposphere, reference frame. An invar-wire creepmeter is a buried mechanical extensometer: its failure modes are rainfall, vault temperature, wire creep. They share almost nothing but the fault between them. Agreement between them is therefore worth more than any amount of internal consistency — and disagreement, under SC-11, indicts one of the instruments, never the ground.

VIII.1 The pair channel (instrument under test)

The channel: fault-parallel differential displacement between two GPS stations straddling the trace, daily NGL IGS20/IGS14 solutions (data source: Blewitt, Hammond & Kreemer 2018, Eos), canonical model (Omori log-decay from the 2004 M6.0 + linear + annual + semiannual — ONE model, pinned in closure_hunter v1.1; the fork's two-Omori defect is closed) removed; the residual is the instrument's output. Five pairs instrumented at Parkfield; primary pair CARH-HUNT (cross-fault baseline 2.69 km decomposed / 2.7 km independent — the two reconciliation tails measured it blind and matched). Floors, per the calibration of record (statistic: residual slope over window W ; held-out null pair, never used for threshold setting, per U1): $W = 30$ d: threshold 33.3 mm/yr, $fa_{\text{realized}}(\text{held-out}) = 0.011$ ($n = 977$) $W = 60$ d: 13.6 mm/yr, $fa = 0.022$ ($n = 494$) $W = 90$ d: 10.1 mm/yr, $fa = 0.000$ ($n = 328$) $W = 180$ d: 4.9 mm/yr, $fa = 0.000$ ($n = 163$) (Field-wide fa before pair-specific calibration ran 0.13–0.21 — the difference is the cost of skipping held-out calibration, kept in the record as a warning.)

VIII.2 Method one: the event/transfer validation (external integer gate)

Design (SC-1 enacted): the USGS creepmeter catalog supplies a 40-event discrete creep catalog (2005.3–2013.3, XPK2/XMM1/TABC family). The instruments and their long-run behavior are documented in Langbein, Murray & Snyder 2006 (BSSA 96(4B), S304–S320, doi:10.1785/0120050823); the data themselves are formally published as Langbein, Bilham, Snyder & Ericksen 2024 (USGS Open-File Report 2024-1011), cited here as

data provenance. One instrument caveat is carried from the primary record into ours: the BSSA 96-4B e-supplement documents that XMM1 responds to nearby explosions — a real, citable failure mode for a member of this cross-match family, kept on the books per SC-11 (suspect your instrument first). Those event epochs gate the GPS pair channel — energy is normalized PER EVENT, not per day (the event-camera reparametrization; time-normalization drowns the same signal by two orders of magnitude, measured). Results (window: 2005.3–2013.3; pairs: CARH-HUNT, POMM-CAND; statistics named): - Gated change-energy $0.253 \text{ mm}^2/\text{event}$ vs measured null offset $0.208 \rightarrow$ recovered signal $+0.045 \text{ mm}^2/\text{event}$ (CARH-HUNT); $+0.081$ (POMM-CAND). - Transfer function: GPS step amplitude vs signed creepmeter slip across the full 40-event catalog: $r = +0.40$ and $+0.35$ ($p \approx 0.01$ each; two independent pairs). Purity of event-matching 3/3 on the detection-grade events. - THE HEADLINE DISTINCTION: the channel detects 3/40 events (above its floor) but TRACKS 40/40 in proportion when externally gated. Detection floor and measurement floor are different numbers. An instrument can measure below its own detection floor if an orthogonal reference tells it where to look. The field already has a name for this and we adopt it: SUB-THRESHOLD MATCHED FILTERING / SUB-THRESHOLD RECOVERY, the gravitational-wave search literature's term (LIGO/Virgo) for recovering events below the standalone detection threshold when an external trigger supplies the epoch. This is SC-7's orthogonality requirement bearing fruit, and it is the single most reusable sentence in this section. - Honest weak spot, kept: the raw (unweighted) stacked mean across all 40 events is marginal (-1.8σ vs null) — small-event dilution. The specified cure (amplitude-weighted matched stack, E6) is pre-registered for the next campaign, not retrofitted into this one.

VIII.3 Method two: the band-coherence validation (and the trap it survived)

Design: does the pair channel independently recover the afterslip that the co-located creepmeter recorded? Overlap window 2006–2013 (the smooth post-2004 afterslip tail; the archive snapshot ends mid-2013). THE TRAP, NAMED FIRST (dipole liar, ledger item 23): raw cumulative correlations between any two smooth afterslip decays run $0.98\text{--}0.997$ with permutation $p \approx 0$ — and carry zero co-location information; CARH-HUNT "correlates" as well with meters 20+ km away as with its 0.4 km neighbor. All raw-shape correlations were rejected on this control before any claim was made. Under SC-11 the dipole liar is not an adversary — it is our own statistic confessing that it measures trend-sharing, not slip-sharing. THE CLEAN TEST: sub-seasonal band (20–150 days), afterslip + annual + semiannual removed from BOTH instruments, each pair against each of six footprint creepmeters (30 tests, Bonferroni-corrected): - CARH-HUNT $\times$ XTA1 (0.4 km co-located): $r = 0.585$, phase-randomization $p < 0.0001$ (5000 surrogates; survives Bonferroni over all 30). - Spatial specificity: the correlation peaks on the co-located meter, decays with distance, and FLIPS SIGN on the SE different-regime meters — the signature of shared near-field fault slip; a regional weather driver would not flip sign. (Residual caveat, kept: a common sub-seasonal environmental driver at the 0.4 km scale cannot be 100% excluded; the sign-flip argues against it.) - All other pairs: at floor ($|r| \leq 0.2$ with their co-located meters), exactly as the resolution-mismatch pre-registration predicted — daily cGPS differentials at $\sim 2000 \text{ nstr/yr}$ resolve only the largest, closest, most-active slip.

VIII.4 The dual-method verdict

Two methods, two failure philosophies — one event-discrete, one band-continuous; one gated by an external integer channel, one coherence-tested against surrogates — both landing on the same pair, the same meter, the same verdict: THE PAIR CHANNEL MEASURES REAL FAULT SLIP. Scope, calibrated: validated as a measuring instrument for co-located, high-activity slip; NOT validated as a discrete-transient detector (the 20-year transient hunt was empty above floor, and the sub-annual Parkfield hunt returned an honest empty at the

loop aperture). Where the two tails' creepmeter subsets differed (event-rich XPK2/XMM1/TABC family vs the six-meter footprint set with no in-window discrete population), the union view is adopted: both statements are true of their own subsets, and both stand (reconciliation D1).

VIII.5 Supporting closures folded into v4.2

- SELF-CALIBRATED POLE: the network's self-fit rotation pole (-4.20°N , -88.70°E , $0.1943^{\circ}/\text{Myr}$; 23 plate-interior stations) agrees with the ITRF2014-PMM North America pole (Altamimi, Métivier, Rebischung, Rouby & Collilieux 2017, GJI 209, 1906–1912, doi:10.1093/gji/ggx136, Table 1: -5.18°N , -88.02°E , $0.1937^{\circ}/\text{Myr}$) to 2.1% in the full angular-velocity vector (0.32% in rate; 1.2° pole-axis separation). Self-fitting a plate frame from regional GPS follows established practice of the data provider's own group (Blewitt, Kreemer, Hammond & Goldfarb 2013, J. Geodyn. 72, 11–24, the NA12 frame) — lineage, not novelty. The post-subtraction residual (~ 2 nstr/yr) is consistent with the expected GIA contamination of geodetic plate-motion models: Altamimi et al. 2017 state their PMM "may be slightly but significantly contaminated by GIA," with induced horizontal velocities up to 3–4 mm/yr even outside classic GIA regions, so this residual is expected and is not chased to zero by this method. (The Kreemer-group references — Blewitt, Hammond & Kreemer 2018, Eos, the NGL data source; Blewitt et al. 2016, MIDAS; Kreemer, Blewitt & Klein 2014, GSRM — are cited for those roles, not as this comparison target. Frame note: NGL current solutions are IGS20/ITRF2020-aligned; the ITRF2014 $\rightarrow$ 2020 NOAM pole shift is well below the 2% claimed, so the comparison stands, with ITRF2020-PMM as an optional future refinement.)
- P532 AUDIT (footnote of record for the tumbler ternary map): the largest profile residual in the Parkfield network (-5.6 mm/yr fault-parallel, 25-site atan-profile fit, full-span window) is REAL — the velocity contrast collapsing at the creeping $\rightarrow$ locked Cholame transition, evidenced by 5/5 antisymmetric down-strike residual signs (fast side pulled down, slow side pulled up, both toward the midline; P539 mirrors P532 at the same along-strike position). Monument healthy (segment velocities stable ≤ 1 mm/yr over two decades; noise mid-pack); documented steps quantified (antenna 2015.861: -2.5 E / -2.8 N mm; Ridgecrest 2019.507: -5.4 E mm) and immaterial to the residual (v_{par} moves ≤ 0.25 mm/yr under full correction). Outer-loop curl -334.3 nstr/yr (7-station polygon, circulation/area, full-span secular) is robust to any P532 velocity choice at $\leq 4.2\%$ — below the 7.7% median jackknife scale. Under SC-11 this is the exemplary case: the anomaly was interrogated as a possible instrument confession and turned out to be the model confessing instead — a 1D single-(V,D) profile cannot represent an along-strike locking transition. Footnote, not rerun.

Part IX — THE CASCADIA CAMPAIGN: REPRODUCING A KNOWN SIGNAL ON AN EXTERNAL CLOCK (v4.2)

IX.1 Design — and what this campaign is, relative to the literature

Positioning first (ruled at the literature pass): superposed-epoch GPS stacking of ETS deformation on tremor catalogs is established art — Bartlow 2020 (GRL 47, e2019GL085303, doi:10.1029/2019GL085303) separates Cascadia GNSS into ETS and inter-ETS components with along-strike variation; Bartlow et al. 2011 (GRL 38,

L18309) established the space-time slip/tremor correlation; Michel, Gualandi & Avouac 2019 (Pure Appl. Geophys. 176, 3867) resolved slow-slip kinematics from the same networks. This campaign therefore DETECTS NOTHING NEW TO GEOPHYSICS: its result REPRODUCES the known ETS surface-deformation signal and is CONSISTENT WITH that literature. What the campaign tests is the instrument — whether this pipeline, run blind on an external clock with documented-equipment masking and a held-out foreign network for false-alarm accounting, reproduces the known signal at its stated floors. "Detection" below is the pipeline's internal statistic (signal vs shifted-clock null), never a priority claim. Sixteen episodic tremor-and-slip (ETS) events, 2007.06–2024.65, northern Cascadia, with the event clock taken ENTIRELY from outside the geodetic data: the PNSN tremor log and published episode dates (the 2023 and 2024 episode bounds — Apr 4–25, 2023 and Aug 6–Sep 6, 2024 — pulled from the PNSN log during the campaign; the split 2019 year resolved to the November 7–27 episode as clock entry, with the anemic August sub-episode logged as a known pre-window contaminant). Network: 25 NGL stations; held-out null network: 23 Great Plains stations, never touched during threshold setting (U1). Statistic (pre-registered): d = mean displacement in (+8..+45 d) minus mean in (–45..–8 d) around each clock date, per station, projected on a fixed seaward azimuth (240°); network mean per event S_k ; full stack S = mean over events. Null: 1000 shifted pseudo-clocks (common shift, ±60–200 d, spacing preserved).

IX.2 The equipment mask (correlated maintenance, not malice)

All documented equipment epochs (NGL steps database) were offset-corrected and excised ±4 d; any station with an equipment step within ±45 d of a clock event was dropped from that event's stack (drop the witness). The 2019 fleet maintenance campaign — FIVE stations re-antennaed in two days (ARLI, NEAH, P401: Jun 4; P402, P403: Jun 5) inside a rolling March–July wave of elevation-cutoff and receiver changes — is the standing example of why correlated-by-date masking is mandatory: maintenance campaigns step many witnesses at once, and any single-culprit assumption breaks on them (SC-7 live sighting, of record). Three direct step-on-event collisions were caught and masked (SSHO radome inside the Jan 2007 ETS; P440 inside Mar 2017; COUP inside May 2018).

IX.3 The frame confession (Amendment A1, kept in the text on purpose)

The original registration specified the detection sign as anti-secular, assuming a plate-fixed frame. The data frame is IGS14, where the secular motion of these stations is itself southwest-directed (azimuths 211–230°; North America plate motion dominates the global-frame secular). The effect duly arrived at $|z| = 9.8$ in the OPPOSITE registered tail: the pre-registered test FAILED AS WRITTEN. The amendment (A1, logged before the rerun) replaced the frame-dependent projection with a physics-fixed seaward azimuth. This episode is printed rather than buried because it is SC-11 operating exactly as specified: the anomaly was a confession by our frame, hunted down as observer error, corrected in the open. Nature did not move; our anchor did.

IX.4 Reproduction result of record (the pipeline's detection statistic)

Full-stack $S = +2.504$ mm seaward (statistic, window, pair as in IX.1); shifted-clock null -0.466 ± 0.270 mm $\rightarrow z = +11.0$. Eleven of sixteen events individually exceed the 99th-percentile per-event threshold (+1.82 mm). Station-event coherence: 345/381 positive (91%). Held-out false alarms: Great Plains, same clock, same thresholds — per-event $fa_{realized} = 1/16$ (0.06). One threshold artifact is recorded rather than hidden: the full-stack 99th-percentile threshold, inherited from the Cascadia null, is negatively biased by the residual staircase (the clock-far detrend leaves inter-event treads sloping against the jumps), collapsing that percentile to ≈ 0 ; the Great Plains stack (+0.236 mm) formally crossed it while sitting at $z = +0.40$ against its own null — no signal in

the Plains, a miscalibrated absolute bar in the pipeline. The symmetric / per-network threshold fix is pre-registered for the next campaign (E7), not retrofitted here.

IX.5 Plaquelette localization: a strong signal below a sample-size ceiling

Scope discipline first (SC-10): on this network, plaquelette DETECTION is scoped-dead and was not retried; the plaquelettes' one job here is along-strike front timing. Five station plaquelettes, South Puget Sound to mid Vancouver Island (along-strike span ~156 km), per-event front timing from the steepest seaward step of each plaquelette-mean series. PRE-REGISTERED TEST: median Spearman ρ (timing vs along-strike position) > 0 AND sign-test $p < 0.05$ AND implied speed 3–20 km/day. RESULT: NOT PASSED — median $\rho = +0.73$ and median speed 6.4 km/day both land in the physical band, but the sign test reads 11/16 positive, $p = 0.21$ ($n = 16$ cannot clear 0.05 below 13/16). The distinction matters and is stated plainly: the migration signal is strong and physically correct — the failure is one of sample size, not of signal. A median ρ of +0.73 with a 6.4 km/day speed is not a weak tendency; the pre-registered sign-test simply cannot reach $p < 0.05$ at sixteen events below thirteen positives, so the honest verdict is not-passed *for want of events*, not for want of effect. Under SC-10 (domain-scoped verdicts) this non-pass binds only this network at this sample size: it is not a verdict on nested plaquelettes as a method, which serve their localizing role on the denser arrays of other spokes. The bar stood; a real and correctly- signed signal did not clear it at $n = 16$; both facts are reported. Along-strike ETS migration is itself established art: Rousset, Fu, Bartlow & Bürgmann 2019 (JGR 124, 13392, doi:10.1029/2019JB018724) report ~8 km/day tremor-migration speed; our 6.4 km/day is CONSISTENT WITH that value, and this section's registered non-pass already keeps the plaquelette ladder to a consistency read rather than an independent-timing claim — the two protections (precedent citation; failed bar) are kept together on purpose. What the data show, recorded as learning and not as a pass: six events with $\rho \geq 0.9$ ladder cleanly from South Puget northward (2007, 2008, 2010, 2013, 2020, 2021); migration is dominantly northward (11/16), matching the tremor-log pattern; and the 2012.71 event ran cleanly SOUTHWARD ($\rho = -0.90$, ~7 km/day) — a genuine direction reversal that earns its own line. A sharper statistic (permutation on mean ρ , which reads $\approx z = +4$ post hoc on this data and is therefore claimed as NOTHING here) is pre-registered for the next campaign. The paper is stronger for showing a pre-registered bar that a real tendency failed to clear than it would be for hiding either fact.

IX.6 What this campaign adds to the instrument

The loop/stack machinery reproduces a known geophysical process — the ETS deformation signal of the Cascadia literature — at high internal significance using ONLY an external clock, documented-equipment masking, and a held-out foreign network for false-alarm accounting; the result is consistent with the established superposed-epoch record, and the campaign's contribution is the protocol (masking + held-out-fa + external clock), not the signal — with its two failures (frame sign; localization bar) printed and pre-registered into the next campaign. Event-normalization (SC-1) operated at network scale: the entire campaign is the event-camera reparametrization applied to a subduction zone.

Part X — THE INSTRUMENT DATASHEET (v4.2)

The honest instrument publishes its own visibility. Two artifacts of record constitute the datasheet and are reproduced (figures + JSON) from the archive: - THE VISIBILITY MATRIX: 8 deformation modes $\times$ 6

channels, built by matched injection; the shear channel closed its row with a perfect diagonal (1.00 / 0.00). The matrix is the instrument's contract: which physical modes each channel can see, at what aperture, and — as important — which it cannot. Detector proposes, topology disposes. - THE TUMBLER TERNARY MAP: four regions, four signed seams (Cascadia compression, Parkfield curl, Long Valley divergence, Great Plains null), plate-motion subtracted, each region's 4-component gradient-tensor signature (curl/div/shear pair) of record. The gradient-tensor read has the deepest root in geodesy: strain and rotation estimated from triangulated station networks goes back to Frank 1966 (carried forward through the Prescott and Feigl lineage); this map is that method's modern GNSS form, and is claimed as nothing more. Carries the P532 footnote of §VIII.5. The Parkfield entry additionally satisfies the simple-shear identity as an internal consistency check. The four signed signatures of record (nanostrain/yr, plate-subtracted, gradient-tensor): Cascadia outer curl -14, div -65, shear [61]; Parkfield outer curl -277, div +80, shear [281], inner-on-seam curl -1008, div -372, shear [1137]; Long Valley curl -79, div +192, shear [71]; Great Plains null curl -1, div -2, shear [1] (self-calibrated to zero). Visibility-matrix S-row (the closed blind spot): shear channel 1.00, all five other channels 0.00–0.05.

Part XI — THE STAR SPOKE OPENS (v5) — same discipline, new sky

XI.0 What crossed the domain boundary (and what did not)

Explicit scope, first sentence: the topological channels of this program — winding, framed twist, Hopf linking — remain geodetic and make no appearance in this section. What generalizes is the OPERATING DISCIPLINE (validate against ground truth; pre-register the traps; publish the floors and the breaks) and the spectral/coherence toolset under three guards that are the star-domain form of the matched-filter law: log-background handling, NATIVE resolution for measurement (zero-padding manufactures fake smoothness), and the window function as alias control. This section is an OPENING, not a closure. Under SC-11, a star is the honest witness par excellence: every anomaly below is an instrument or method confession, and two of them are printed.

XI.1 First light, red giant (KIC 8366239; 4.0 yr Kepler long cadence,

55,001 points) - $\Delta v = 13.67 \mu\text{Hz}$ vs published ≈ 14 — recovered to $\sim 2\%$; $v_{\text{max}} \approx 189 \mu\text{Hz}$ (background-sensitive, flagged). The mode comb is real. - THE BREAK, PRINTED: naive triplet-picking on the $l = 1$ forest failed exactly as pre-registered — mixed p/g modes make "top three peaks" return forest density, not rotation; zero-padded splits of $0.10\text{--}0.16 \mu\text{Hz}$ collapsed to $0.04\text{--}0.06 \mu\text{Hz}$ at native resolution with 26–134% asymmetry. The simple tool has a real floor here; it is in the paper because floors are results. - Rotation recovered by the right tool: autocorrelation across the whole forest gives $\delta v_{\text{rot}} \approx 0.417 \mu\text{Hz}$ with its $2\times$ harmonic at $0.81 \mu\text{Hz}$, passing three controls ($\Delta v = 13.64$ re-recovered in the same ACF; $0.42 \mu\text{Hz}$ is not the $\sim 2.5 \mu\text{Hz}$ mixed-mode spacing; window power at $\pm 0.417 \mu\text{Hz} = 0.0003$ — not a monthly-gap alias). Core-sensing rotation of order two weeks. Honest boundary, named: the depth-resolved core-vs-envelope profile requires the asymptotic mixed-mode machinery ($\Delta\Pi$, coupling q , trapping ζ , stretched échelle) — the next tier, not tonight's claim.

XI.2 First light, sealed-core dwarf (KIC 10963065; 3.7 yr short cadence,

962,037 points) - $v_{\text{max}} = 2244 \mu\text{Hz}$ [published ~ 2200]; $\Delta v = 102.76 \mu\text{Hz}$ [published ~ 103]; small separation $\delta v_2 = 6.8 \mu\text{Hz}$, $r_2 = 0.066$ [solar ≈ 0.06] — the age clock, consistent with the published ~ 4 Gyr. - Scaling-relation mass came in HIGH (1.24 vs $\sim 1.05 M_{\odot}$) — the known scaling-relation systematic, flagged and not

smoothed; grid modelling with the extracted frequencies is the standard cure and the stated next step. - THE PARITY LADDER (predicted, then measured): $l = 1$ modes sit a constant $4.0 \pm 0.38 \mu\text{Hz}$ off the midpoint of their $l = 0$ neighbors — scatter 0.4% of $\Delta\nu$. This is the asymptotic $l/2$ half-step (even l on integer rungs, odd l on half-integer rungs) — standard theory, but here it was drawn from the program's own half-step/double-cover thread (ledger items 49/50) BEFORE being checked against the data, and the contrast with the red giant closes the loop: open core → mixed-mode forest → ladder broken; sealed core → ladder pristine, 0.4% rigid. A conceptual resonance of record — explicitly NOT a topological measurement claim.

XI.3 The spoke's status line

Two stars, both validated against published ground truth, two honest breaks printed, zero novelty claimed: standard asteroseismology executed under this program's discipline, establishing that the discipline itself is domain-portable. Next targets are staged (16 Cyg AB; the mixed-mode stretched-échelle tier), and they belong to their own sessions.

Part XII — ROADMAP HELD, NOT CLAIMED (v6)

The sky application (topological invariants in pulsar-timing residuals, astrometric E/B modes, CMB, quasar catalogs) is carded and remains a card. It has no data, no session, and no results, and this paper claims none.

Prior art and positioning (literature pass run 2026-07-09; citations verified from primary at W1)

This section replaces the former "Literature-pass flags (unrun)": every flag has now been run, and the verdict is stated plainly — EVERY MECHANISM IN THIS PAPER IS PRIOR ART, and for a synthesis paper that is the win condition. The candidate contribution is the ASSEMBLY plus the EXTERNAL VALIDATION. Line by line:

- GATE ECONOMY (the founding move): QEC syndrome-gated decoding. The null-gated form is patented — US 9,748,976 (Northrop Grumman, granted 2017; Bacon-Shor code; decoder logic fully inactive on a null syndrome). This paper's contribution is the PORT of that economy onto natural conserved-quantity fields (Parts I/II). [ADJ, not NEW.]
- TOPOLOGICAL ANOMALY DETECTION: US 10,333,958 (persistence-diagram anomaly detection: Vietoris–Rips filtration, learned persistence diagram, bottleneck-distance comparison at detection) is the direct topological-anomaly-detection precedent, and the surrounding persistent-homology anomaly literature is dense and fast-moving. [Deposit diligence 1: reconfirm assignee/inventor line.]
- L1, GPS–creepmeter cross-validation at Parkfield: prior art confirmed — Langbein, Murray & Snyder 2006 (BSSA 96(4B), S304–S320, doi:10.1785/0120050823); data provenance Langbein, Bilham, Snyder & Ericksen 2024 (USGS OFR 2024-1011). Our claim is strictly "this pipeline's channel validated against

that program's instruments." The XMM1 explosion-response caveat (BSSA 96-4B e-supplement) is carried in §VIII.2.

- L2, ETS superposed-epoch GPS stacking on tremor catalogs: established — Bartlow 2020 (GRL 47, e2019GL085303, doi:10.1029/2019GL085303); Bartlow et al. 2011 (GRL 38, L18309); Michel, Gualandi & Avouac 2019 (Pure Appl. Geophys. 176, 3867). Part IX is worded throughout as REPRODUCING / CONSISTENT WITH this record, never as detecting anything new; the campaign's contribution is the protocol (external clock + correlated-maintenance masking + held-out foreign-network false-alarm accounting).
- L3, along-strike migration: Rousset, Fu, Bartlow & Bürgmann 2019 (JGR 124, 13392, doi: 10.1029/2019JB018724) report ~8 km/day; our 6.4 km/day is consistent with it, and §IX.5's registered non-pass independently prevents any stronger claim. Double-protected, both protections kept.
- L4, event-gated energy: the econometric cousin — bipower variation / jump detection (Barndorff-Nielsen & Shephard; Lee & Mykland) — is cited as ancestry in Part II.
- L5, astero seismic results: both stars are published benchmarks and the star section claims recovery only; the star quotes were verified clean at the pass, but the star section (v5) owes its own dedicated literature and number-confirmation pass before deposit of any stellar claim. Its numbers are untouched by this edit.
- L6, "detection floor ≠ measurement floor": the field's terminology — SUB-THRESHOLD MATCHED FILTERING / SUB-THRESHOLD RECOVERY (gravitational-wave search literature, LIGO/Virgo) — is adopted at §VIII.2.
- L7, pole comparison: citation corrected at W1 (it is Kreemer, Hammond & Blewitt 2018, JGR Solid Earth 123, 4388–4412, doi:10.1029/2017JB015257 — not "Blewitt & Klein," which belongs to the 2014 GSRM line); four-way disambiguation and the unresolved comparison-target note are at §VIII.5. [Deposit diligence 2.]
- CONTINUOUS HOLONOMY INSTRUMENTATION (cite-and-distinguish): Manaka et al. 2026 (arXiv 2604.10521, Apr 2026; arXiv 2606.13074, Jun 2026 — cited as 2026 preprints, peer review pending) read a continuous/analog holonomy in SrTiO_3 as a geometric/connection descriptor of strain incompatibility and EXPLICITLY DISCLAIM topological-invariant status. That makes them the precise cousin of this paper's CONTINUOUS (curvature-content) holonomy read — and distinct from our INTEGER/topological channel, which their work does not claim. Clean cite-and-distinguish.
- T2.b, the geodetic root: strain/rotation from triangulated networks is Frank 1966 (with the Prescott and Feigl lineage); the gradient-tensor signatures of Parts VIII/X are its modern GNSS form (cited at Part X).
- T2.c, consensus framing: the array's agreement machinery is ROBUST ESTIMATION among noisy honest sensors, not Byzantine fault tolerance (SC-12); "Byzantine" appears in this paper only as borrowed vocabulary, and the equipment-mask section (§IX.2) already frames correlated maintenance as campaigns, not malice. No adversary is invoked on a natural substrate (SC-11).
- T2.a, THE ASSEMBLY CLAIM (this paper's most exposed claim, worded with care): for the specific assembly — a topological integer guard gating a sleeping expensive channel, wired with a coherence committee and a homotopy ladder, and externally validated against an independent physical instrument — WE FOUND NO PRIOR ASSEMBLY IN A BOUNDED ADVERSARIAL SEARCH. That is "not found," never "none exists": the search was bounded, the persistent-homology-anomaly neighborhood is large and fast-moving, and this claim stays PROVISIONAL until an expert room or a counterexample settles it.

Reference-list completion note (reconstruction, logged per protocol): the L4 (Barndorff-Nielsen & Shephard; Lee & Mykland) and L6 (LIGO/Virgo sub-threshold) citations were verified at the concept/author level in the W1 pass, which recorded no full bibliographic strings; the exact strings enter the reference list at the formatting pass and are deliberately NOT re-keyed from memory here.

Appendix — Numbers of record (v4 session)

Coherence: $N=900$, SNR 0.15, FA 1% $\rightarrow$ 100.0% (7.9 σ); scrambled 1.1%; energy 4.4%; best-sensor 1.5%. Twist: A/B separation 15.5 σ ; chirality sign ± 1.0 . Linking: Hopf 0.00/−0.064/−0.124/−0.176 as $w_3=0..3$, circulation pinned 1.96, wrapping pinned 0.78. π_2 : raw P(correct) 1.00 ($\sigma=0.3$), 0.08 ($\sigma=0.6$); smoothed $\times 2 \rightarrow$ 1.00 ($\sigma=0.6$), 0.88 ($\sigma=0.9$). Pose: scalar loop sum = 0 (machine epsilon); E-leakage into circulation = 0 (identity); smoothed circulation vs 0.3%-power curl $r=0.23\pm 0.10$ (naive -0.01 ± 0.03). Byzantine: inconsistency 0.21 (real) vs 1.21 (4 compromised), 5.7 $\times$. Fingerprint: particle flux 1.0/curl -0.02 ; wave curl 0.53/flux -0.03 ; field quadrupole-dominant. Tessellation: dodecahedral worst-gap 37.0° vs flat 47.1° (1.27 $\times$), uniformity 8.05 vs 9.96. Zeta: guard 125/125; violations $n=126,134$; Lehmer gap 0.0377, graze 0.00397; spacing variance 0.144 (Poisson 1, GUE 0.273, crystal 0); number variance ≈ 0.30 saturating at $L \gtrsim \ln(T/2\pi)/\ln 2 \approx 7$. Representation bench (v4.1): abelian equivalence -1.0471975512 all five styles; ternary survival identical across styles (1.00/0.91/0.76/0.61/0.52 at $\sigma=0.05-0.80$); gimbal — quaternion 2×10^{-14} flat, Euler $1.5\times 10^{-12} \rightarrow 2.4\times 10^{-9}$ as pitch $\rightarrow \pi/2$ (500 junction round-trips, jitter 10^{-7}); spinor bit $q_0 = -1.000000$ (2π), $+1.000000$ (4π), SO(3) error 1.5×10^{-14} (blind); projection bias at zero noise: residual $-1.047 \rightarrow -1.353$ rad, ternary survival 1.00 $\rightarrow$ 0.52 as out-of-plane rms 0 $\rightarrow$ 0.6; wind-vs-wander 12.7 σ , 100% at 1% FA.

Provenance: the homotopy ladder and the dodecahedral-observer question were specified in the June corpus (Appendix X, "the master spine": π_0 kink / π_1 winding / π_2 hedgehog / π_3 instanton / Atiyah–Singer capstone; D12/D20 settled in the X addendum). This paper's contribution relative to that spec is the channel wiring — the coherence channel, the guard-gates-expert economy, the matched-filter law, the projection law, and the Byzantine-vs-anomaly discrimination — plus the July validation of the June spec: spec in June, kill-tests in July, three weeks apart, independent sessions, converging. All v4 measurements executed in-session July 8 2026 (representation-bench numbers same date, code retained in logs and in rep_bench_v0.py). Drafted collaboratively; every claim fenced per the beat-a-baseline rule; mechanism novelty disclaimed throughout. The candidate contribution is the wiring, pending the literature pass that is this paper's own next gate.

v4.1 edit log (2026-07-08): (1) Part IV heading and body — "new in v4" corrected to "question settled June (Appendix X addendum), numbers measured July"; (2) Part II — projection law added as the matched-filter law's representation-space twin, with the gimbal corollary; (3) Appendix — representation-bench numbers of record added; (4) this provenance footer — June/July credit boundary drawn explicitly. No result of record changed. Related merge logged in the register, not the paper: June orphan #1 (Möbius write-line, orientability $\mathbb{Z}_2$) and item 26 (spinor cap) are one channel type — a $\mathbb{Z}_2$ -holonomy sign bit — under two distinct mathematical names (w_1 vs w_2); the names are not collapsed.

v4.2 geodetic (July 9): Self-fit NA Euler pole (23 null-region stations, IGS20) -4.20 deg N / -88.70 deg E, 0.1943 deg/Myr (agrees with ITRF2014-PM, Altamimi et al. 2017, to 2.1% full-vector / 0.32% rate / 1.2 deg pole separation; self-calibration per Blewitt et al. 2013 NA12); rigid-fit rms 1.40 mm/yr; null closes to curl -0.5 /

div -1.9 / |shear| 1.2 nstr/yr (instrument absolute floor ≤ 2 nstr/yr). Tumbler ternary (secular, plate-subtracted, 3-sigma bootstrap): Cascadia (0,-1) div -60.1 $\pm$ 0.5; Parkfield (-1,+1) outer curl -330 $\pm$ 2.5, inner-on-seam curl -1404 $\pm$ 63 (loop) with the simple-shear identity $|\text{curl}| \sim |\text{shear}| \sim 1100$ (gradient fit); Long Valley (-1,+1) div +200 (curl retired to config-artifact by jackknife). Visibility matrix (real noise, FA 1 percent, 2.65 mm RMS): perfect six-channel diagonal - T identity-blind (loops 0.00, point detectors false-fire 0.30-0.50); R+/R- curl 1.00 with signs +1/-1; D+/D- flux 1.00 with signs +1/-1; S pure-shear caught only by the shear channel (1.00) after it was built (theorem blind-spot closed). Pair channel: CARH-HUNT baseline 2.70 km; floors (held-out fa) W=90d 10.1 mm/yr (fa 0.000). External validation, event/transfer: gated energy 0.253 vs null 0.208 mm²/event, transfer $r=+0.40/+0.35$, detect 3/40 track 40/40; band-coherence CARH-HUNT x XTA1 (0.4 km) $r=0.585$, $p<1e-4$ Bonferroni-survived, sign-flips on different-regime meters. Cascadia ETS: full-stack $S=+2.504$ mm, shifted-clock null -0.466 $\pm$ 0.270 $\rightarrow z=+11.0$, 11/16 events, 91 percent coherence; held-out Great Plains fa 1/16; localization NOT passed at bar (median $\rho=+0.73$, sign 11/16 $p=0.21$; 2012.71 clean southward reversal $\rho=-0.90$). Byzantine mask: antenna-class equipment steps concentration z up to +17, ETS max +3.5, zero false alarms on real physics.

v5 stellar (July 9): KIC 8366239 (red giant, 4.0 yr Kepler long cadence) large separation Delta-nu recovered to 2 percent of published; rotational splitting delta-nu_rot ~ 0.417 microHz survived three controls. KIC 10963065 (dwarf, 3.7 yr short cadence) envelope tower $r_{02}=0.066$; parity ladder predicted-then-measured. Spoke status: opening, not closed; asteroseismic pipelines already measure these quantities - the v5 claim under test is whether the topological read adds robustness the power-spectrum pipeline does not (charter pending).

v4.2/v5 provenance (2026-07-09): geodetic and stellar parts assembled from results of record produced July 8-9 across two reconciled work-tails (see reconciliation log); every number checked against primary records at merge. Parts VIII-XI drafted in the P2 session, inserted here against the frozen v4.1. Failures are kept in the text by policy (the frame-sign confession IX.3, the localization non-pass IX.5, the small-event dilution, the miscalibrated Great-Plains full-stack threshold). The literature pass (flags above) is unrun and gates the expert room. [Historical log, kept verbatim; superseded by the v4.3 edit log below — the pass has since run and the flags section is now "Prior art and positioning."] The contribution remains the wiring; every mechanism is prior art.

v4.3 edit log (2026-07-09, the W2 literature-pass edit session). Sources of authority: the P1 verdict register (2026-07-09_ledger_lit-pass-verdict-register.md, edits 1–10 approved with Caveats A and B) and the W1 citation-confirmation ledger (2026-07-09_ledger_W1-citation-confirmation.md, both passes; final ruling ALL CLEAR, two deposit-diligence notes). Nature of this edit: rewords, citation inserts, and framing corrections ONLY — no new results, no new claims, no result removed; all failures retained (IX.3 frame confession, IX.5 localization non-pass, small-event dilution, Great Plains threshold artifact). Edit-number mapping (reconstruction, noted per protocol: the register lists verdict BINS, not numbered edit texts; the mapping adopted is edits 1–7 = L1–L7, edit 8 = T2.a wording, edit 9 = T2.b citation, edit 10 = QEC relocation): (1) L1 — Langbein, Murray & Snyder 2006 + Langbein et al. 2024 data provenance + XMM1 caveat inserted at §VIII.2 and Prior-art. (2) L2 — Part IX retitled and reworded as reproduction/consistent-with (never "detects" relative to literature); Bartlow 2020 / Bartlow 2011 / Michel 2019 cited at §IX.1 and Prior-art. (3) L3 — Rousset et al. 2019 (~ 8 km/day) cited at §IX.5; 6.4 km/day worded "consistent with"; non-pass kept as second protection. (4) L4 — bipower-variation/jump-detection cousin (Barndorff-Nielsen & Shephard; Lee & Mykland) cited at Part II event

time. (5) L5 — star section untouched per scope; its own pass owed, stated at frontmatter and Prior-art. (6) L6 — "sub-threshold matched filtering / sub-threshold recovery" (LIGO/Virgo) adopted at §VIII.2. (7) L7 — Kreemer, Hammond & Blewitt 2018 correction (W1's headline save; register had carried the 2014 author line onto 2018); four-way disambiguation at §VIII.5; comparison target of the 3% stated as unresolved rather than guessed (deposit-diligence 2). (8) T2.a — assembly claim worded "we found no prior assembly in a bounded adversarial search," never "none exists"; PROVISIONAL status stated at Part VII and Prior-art (Caveat A live, reinforced by the dense PH-anomaly literature). (9) T2.b — Frank 1966 (+ Prescott, Feigl) cited at Part X and Prior-art. (10) QEC RELOCATION (load-bearing) — Parts I/II reframed: the guard-gates-expert economy is presented as a PORT of QEC syndrome decoding (US 9,748,976, Northrop Grumman 2017, Bacon-Shor, null syndrome leaves decoder inactive) onto natural conserved-quantity fields; [ADJ], not [NEW]. Additional ruled inserts: US 10,333,958 as the topological-anomaly-detection precedent (deposit-diligence 1); SrTiO₃ continuous-holonomy cite-and-distinguish (Manaka et al. 2026 preprints, arXiv 2604.10521 / 2606.13074 — they self-disclaim topological-invariant status; our integer channel distinguished); T2.c robust-consensus-not-BFT positioning (SC-12). Frontmatter updated to v4.3 with the two deposit-diligence notes boxed at the top of the paper; former flags section converted to "Prior art and positioning"; Part VII "open and gating" corrected to pass-run status. All cited work paraphrased; nothing quoted substantially. The star section's numbers (Part XI, v5 appendix block) were not touched: v5 owes its own pass. Next gates: the two deposit-diligence notes, then the deposit/formatting pass; the expert room remains available with Caveat A live.

v4.3 addendum (same session, on receipt of the P2 amendment draft): with 2026-07-09_ledger_tripwire-v4_2-v5-amendment-draft.md in hand, two stale internal cross-references were provably identified as merge renumbering artifacts (the draft's "as in VI.1" and "§V.5" were correct in draft numbering but were not updated when V→VIII and VI→IX at the v4.2 merge) and corrected: §IX.4 now reads "as in IX.1"; Part X now reads "§VIII.5". No number changed. The draft was also checked against deposit-diligence note 2: it does NOT resolve which Kreemer pole the 3% self-fit was measured against ("Kreemer et al. 2018" bare, same as the paper); note 2 stands — resolve from the pole-fit logs / calibration JSONs at the deposit pass.

v4.3-final addendum (2026-07-09, deposit-diligence resolution — both notes closed): (1) US 10,333,958 assignee confirmed as Cisco Technology, Inc. (inventors Huang, Ranjan, Zhang, Udupi, Dutta) from USPTO Patent Public Search primary record — the patent IS the persistent-homology anomaly detector (Vietoris-Rips / persistence-diagram learning phase / bottleneck-distance detection), citation stands. (2) The self-fit pole "3%" — previously prose against a recalled value — is resolved: compared as full angular-velocity vectors against the ITRF2014-PMM North America pole (Altamimi et al. 2017, GJI 209, 1906–1912, Table 1), the self-fit (−4.20°N, −88.70°E, 0.1943°/Myr) agrees to 2.1% full-vector, 0.32% rate, 1.2° pole separation — the claim strengthened under audit. Three verified bonuses folded in: the recalled +4.0 nstr/yr Great Plains prediction computes to +4.1 from the published pole (good to 2%); the ~2 nstr/yr null residual is anchored to Altamimi et al.'s own explicit GIA-contamination caveat; and the self-calibration move is shown to be the data provider's own established practice (Blewitt et al. 2013, NA12) — lineage, not novelty. The earlier "unresolved" notes above are superseded by this resolution and retained only as audit trail. The comparison target is Altamimi 2017 (ITRF2014-PMM), NOT a Kreemer pole; the Kreemer-group refs remain cited for their own roles (NGL data, MIDAS, GSRM). Deposit-diligence box: both notes closed; paper is content-final pending formatting, ORCID, and timestamp.