

Prime Front — extracted research

Historical source: `tfpt_3_e8_audit_bootstrap.tex` at revision `ba2f0fc`. Original labels, results and caveats are retained; extraction changes ownership only. Complete original: `provenance/tfpt-source`. The publication assembly omits presentation boxes around excerpts.

Contents

Hecke from geometry on the glue census (HECKE.GEOM.01). The same E_8 theta/ q -series channels that feed the atlas raster now carry an *in-suite* Hecke mechanics, machine-checked as one module ([[verification/v535_hecke_from_geometry.py](#)]). (A) The classical Kneser p -neighbour correspondence (isotropic lines of $(E_8/pE_8, q)$) factors as $\#iso_lines = \sigma_3(p) \# \mathbb{P}^3(\mathbb{F}_p)$ identically and by full enumeration at $p = 2, 3, 5, 7$ (135/1120/19656/137600) — the Eisenstein eigenvalue $\sigma_3(p) = 1 + p^3$ is a lattice-native correspondence count. (B) The marked neighbour-sum operator is an affine Hecke element $\nu_p = a \text{Id} + bT_p$ with $b = \sigma_3 + a_p$ and cusp rule $a_p = b - \sigma_3$, recovering $a_3 = -4$, $a_5 = -2$ (and $p = 7$ consistency $\lambda_{\text{odd}} = 19840$). (C) The seven-dimensional census form space is exactly the 2-adic oldform hull of two weight-4 systems (5 copies of E_4 at levels 1, 2, 4, 8, 16 plus 2 copies of f_8 at levels 8, 16), with recovery projectors $\pi_{\text{cusp}} = (28 - T_3)/32$ and newform via $(1 - V_2U_2)$. Classical theorems (Kneser, Hecke, Atkin–Lehner, multiplicity one) are named classical; the TFPT content is the compiler identification. Honest fence: both new systems stay weight 4 — the $\text{GL}(1)$ /weight-drop transport remains [O]; no RH claim. [E] (mechanics) / [O] (weight drop)

Eichler trace layer at the E_8 lattice (HECKE.GEOM.EICHLER.01). Building on the Hecke package without duplicating it, the census channels now carry a machine-checked Eichler/Witt layer ([[verification/v536_eichler_trace_layer.py](#)]; 23 checks, ~ 30 s). Witt $\lambda_{\text{Eis}} = L - \sigma_3^2$ is closed; the identity $\lambda_{\text{geom}} = \lambda_{\text{Eis}} + a_p^2$ is two-sided at $p = 3$ (live; $352 = 364 - 12$) and at $p = 5$ via a T36-validated freeze ($3784 = 3906 - 122$), with assembler $R = \sigma_3 - 1 - c(p^2)/8 = a_p^2$. Closed Type-A/B densities $N_A = \min(240(1 + p^3), \#iso - 1)$ give the $p = 7$ prediction 82560/743040 live; signed $a_p = -c(p)/8$ recovers $(-4, -2, +24)$. Classical Eichler/Siegel/Witt named classical; Shell(p^2) for $p \geq 7$ out of scope; weight-4 $\rightarrow \text{GL}(1)$ stays [O]; no RH claim; no marker moves. [E] (mechanics) / [O] (weight drop)

Half-integral bridge (HECKE.GEOM.HALFINT.01). Companion package on the same f_8 channel ([[verification/v537_halfintegral_bridge.py](#)]; 20 checks, ~ 90 s). Unique signed Shimura preimage $\text{Sh}_{t=2}(g) = -8f_8$ in the 70-element weight-5/2 compiler theta-monoid; exact $T(p^2)$ -equivariance with eigenvalues $a_p(f_8)$; $U_4(g) = 0$ and level $32 = 4 \cdot 8$ outside Kohnen 1982 (plus-route closed); AFE Waldspurger quotient $R(d)$ constant on ten $d \equiv 1 \pmod{8}$ ($R = 23.1873585645\dots$, spread $\leq 10^{-12}$). Classical scaffolding named classical; $\text{GL}(2)$ centre $s = 2$ (not ξ); no RH; no marker moves. [E] (Shimura/Hecke/Kohnen fence) / [C] (measured R)

Compiler relative-trace identity (HECKE.GEOM.RTF.01). Synthesis of the three Hecke/Eichler/half-integral packages as projections of one finite relative-trace identity ([[verification/v538_relative_trace_identity.py](#)]; 18 checks, ~ 14 s). Bilateral $\text{Tr}_V(\nu_p \circ \pi)$ equality at $p = 3, 5, 7$ (geometry without modular input = spectrum without geometry); Eichler $\lambda_{\text{Eis}} + a_p^2$ as the RTF orbit dictionary; period side = signed quaternary lattice counting with measured $R = 23.1873585645$. Verdict ONE-FORMULA. Classical Jacquet RTF named classical; finite identity; infinite/archimedean extension open; no RH; no marker moves. [E] (R1/R2) / [C] (R3)

Weil structure of the compiler family (RTF.GNS.WEIL.01). Route-B synthesis: fully identified Weil structure up to two isolated obstructions ([[verification/v539_weil_structure_family.py](#)]; 25 checks, ~ 6 s). GNS fibre isolation (twist-mix $\leq 5.037 \times 10^{-16}$); $\text{GL}(1)$ core $G_0 = (1 + Y)/(1 - Y) = \zeta_p(w - 3)^2/\zeta_p(2w - 6)$ with $\sum 2^{\omega(n)}n^{-u}$; $Q_{\text{fam}} = 2Q_\zeta(g) - 2Q_\zeta(g_b) + \text{Arch} + \text{Corr}$. Obstruction 1: doubling enters with a minus (family positivity $\nRightarrow Q_\zeta \geq 0$). Obstruction 2: Plancherel Corr non-automorphic ($e^{-\sum p^{-u}}$ -type). Not “almost RH”; dense-class positivity open; ZETA.HP.CARRIER untouched; no marker moves. [E] (structure/obstructions) / [C] (finite-class Q_{fam})

Amplitude route and positive linear carrier (RTF.GNS.AMP.01). The route out of the square plane behind the two v539 obstructions ([[verification/v540_amplitude_linear_carrier.py](#)]; 34 checks, ~ 3 s; T67–T72). Amplitude Dirac $D^2 = \text{diag}(VV^\top, K)$ exact and Hecke-equivariant; polarisation $b = N_+ - N_-$ with $\Theta = N_+ + N_-$ a pure σ_3 -eigenform and Cohen seed $\Theta(d) = -48L(-1, \chi_d)$ (exact-rational, 159 live d); Cauchy–Littlewood deletion pair-independent at $st = uv = p^3$ and equal to the square-class double counting ($\text{fam} + 2b + \delta_{k1} = [2, 2, 2, 2]$); positive linear carrier $\ell^2(d, 48|L(-1, \chi_d)||d|^{-a})$ with full weights $[1, 1, 1, 1]$ and plus balance $Q = Q_\zeta(g_-) + Q_\zeta(g_+)$; FE $\Lambda_\Theta(s) = 8^{1-s}\Lambda_{\Theta^\dagger}(5/2 - s)$ exact (rel $\sim 10^{-40}$, Fricke closed). Open boundary as content: Euler-

region positivity only; the residual distance to the Weil cone is the FE-covariant gap functional λ^* on $n \equiv 6 \pmod{8}$ (Farkas-certified). Not “almost RH”; ZETA.HP.CARRIER untouched; no marker moves. [E] (A–E exact) / [C] (sampled cone facts; λ^* named open)

Matching lemma and transport ledger package (RTF.GNS.LEDGER.01). The T78–T85 proof package, recomputed as one module ([verification/v541_matching_lemma_ledger.py]; 33 checks, ~ 10 s). Window proof: $7S < 40A$ at every $j \leq 10^6$ (0 violations, 939 870 clash atoms; exact margin $X = 0.082159$, $\rho_{\text{crit}} = 1.1440$; structure laws 8-law / seed-tower / ψ w -table / Cohen seeds $\{-48, -80, -8, -8\}$ at 0 tolerance). Transport ledger closes exactly: $Q_{\text{Weil}} = Q_{\text{cert}} + \Delta_{\text{arch}} + \Delta_2$ with $\Delta_{\text{pole}} \equiv \Delta_{\text{conv}} \equiv 0$ proven (residual 4.4×10^{-16} on 24 rows); odd-prime side = certified plus combination (rel 3.9×10^{-16}). Signed envelope character-exact ($-\psi = (\chi_{-4} + \frac{1}{4}\chi_8 + \frac{1}{4}\chi_{-8})\Theta$; signed certificate 0 violations, margin $8.86\times$; confinement set equality). Arch internal via Legendre duplication ($k_\zeta = K_{\text{fam}} - K_{\text{shift}}$ pointwise 7.9×10^{-31} ; $\Delta_{\text{arch}} = A_{\text{fam}} - A_{\text{shift}}$ at 9.9×10^{-16}). Coherent class closed by the λ -equivariant CM channel (g_λ two routes exact; $\mu_1 \in [-1, 1]$ exact; λ -certificate 0.0653 vs 0.2365, $3.6\times$). Frontier facts [C]: coherent-chain crossing $k^* = 14$ ($10^{23.1}$); Robin tail factor 6.16, constant route open. **Named limits as content:** one classically-shaped open lemma (correlated cancellation, non-coherent uniform tail; provably-shaped $\neq$ formal proof) + I5 in one-family form ($Q_{\text{cert}} + \Delta_2 + A_{\text{fam}} - A_{\text{shift}} \geq 0$), by the closed ledger equivalent to Weil positivity $\iff$ RH (equivalence typing, no progress claim). Classics named classical (Gronwall, Robin 1983 unconditional, Cohen 1975, Hecke 1918–1920, Cornacchia, Legendre duplication, Weil 1952, Alaoglu–Erdős). No RH-evidence language; not “almost RH”; ZETA.HP.CARRIER untouched; no marker moves. [E] (window proof / ledger / character / duplication / λ -channel) / [C] (frontier facts; two named limits open)

The margin-chain identities of phase 2 (PRIME.MARGIN.IDENT.01). The identity/theorem block of T128–T131 as one narrow module ([verification/v542_margin_chain_identities.py]; 44 checks, ~ 0.2 s) on 24 small frame-A seam instances ($n = 3 \dots 97$, $\rho = 1.25 \dots 4.00$, every inverted matrix ≤ 300), 43 graded/fine grid pairs and 400 randomised profiles, each identity with a preregistered tolerance and a mutation control. Interval geometry: $\sum_i (1 - g_i) = t_l + t_r$ (5.5×10^{-13}) $\Rightarrow \kappa_{\text{flat}} = 1$ exactly; the (T) identity $\tau = \|y\|^2 - m_{\text{prot}} + m_{\text{fill}} - V_{\text{bord}}$ (2.2×10^{-16} , two independent routes). Profile identity $p_{N-1} = 2 - p_0 + 2E$ with the equivalence $2E > p_0 \iff p_{N-1} > 2$ (0 exceptions); the Abel/Hölder curvature chain per instance (0 violations; without the curvature term violated 88/400). Assembly = $J^T Q J$ and graded overlap = J (5.2×10^{-16} / 5.2×10^{-14}); the C  a/Strang defect identity $S_{\text{graded}} - S_{\text{uniform}} = R^T X^{-1} R$ with PSD defect on all 43 grids (2.1×10^{-14}) $\Rightarrow$ one-sided compression. The secular sandwich on all 48 sections where $A > 0$ and $\varepsilon > 0$ are *checked* (width ≤ 1.4448) with Albert’s sign equivalence in both directions; $S^{-1} > 0 \Rightarrow$ sign-constant simple ground vector as an *implication*; the counting chain $n_{\text{run}} \leq n_{\text{cross}} + 1 \leq s_2 + 2$ and $\sum_j |\Delta p_j - \overline{\Delta p}| = \text{TV}(P)$. **Named limits as content:** per instance on small windows only, nothing uniform in the zone index; the κ law itself is *not* claimed; positivity of the pole-free section at depth stays open; the Perron hypothesis is measured; the defect identity says nothing about the defect’s size. Abel / H  lder / Haynsworth / Albert 1969 / C  a–Strang / Yserentant 1986 / Perron–Frobenius–Ostrowski named classical. [E] (per-instance identities; no marker moves)

The lumped M -matrix pair (PRIME.MMATRIX.IDENT.01). The identity block of T136 as a second narrow module ([verification/v543_lumped_pair_identities.py]; 35 checks, ~ 1 s) on 20 small frame-A seam windows ($n = 4 \dots 59$, $\rho = 1.25 \dots 4.00$, $h = 25 \dots 299$, every factorised matrix ≤ 300), 312 shifted ladder rungs and 8 whitened two-grid rungs, each statement with a preregistered tolerance and a mutation control. The lumped pair $A_B = A + L_\Delta$ is Stieltjes and row-sum preserving (1.6×10^{-15}) with $A_B \succeq A$ — an *upper* bound on $\lambda_{\min}(A)$, never a floor; the congruence $A = A_B^{1/2}(I - W)A_B^{1/2}$ holds as a matrix identity (4.4×10^{-15}) with $\lambda_{\max}(W) = \rho(L_\Delta A_B^{-1})$ and the *declared* equivalence $\lambda_{\max}(W) < 1 \iff A \succ 0$ checked in both directions, so the Loewner sandwich is circular by itself. The M -matrix anchor $\lambda_{\min}(A_B) \geq 1/\max_r x_r$, $x = A_B^{-1}\mathbf{1} \geq 0$, holds on all 39 rows (sharpest ratio 0.9070) from one solve and one sign check; lumping commutes with diagonal shifts and M -matrix inverses are entrywise monotone, so the shifted ladder is structurally

empty (0 of 312); Varga's $\rho(J) = \tau/(1 + \tau)$ is an identity (4.8×10^{-15}) and the Collatz–Wielandt bracket at the anchor vector gives an a-priori $\rho(J) \leq 0.9861 < 1$ with no eigenvalue. One *negative* result: the k -scanned M18 majorant is valid at every k (39 pairs) and still stays above its bar $1/2$ (best 3.080), the bar is not moved. **Named limits as content:** per instance on small windows, nothing uniform in the zone index or in D ; the T136 D -exponents are fits and stay in the sandbox. Stieltjes / Ostrowski 1937 / Fan 1958 / Berman–Plemmons 1979 / Varga 1962 / Collatz–Wielandt named classical. [E] + [X] (one closed route; no marker moves)

The long-lag support structure (PRIME.LONGLAG.SUPP.01). The structure block of T137 as the companion module ([verification/v544_long_lag_support.py]; 24 checks, ~ 0.2 s) on the same 20 windows, 20555 positive off-diagonal edges, 455 loaded stripes, 39 bracketed lumped comparisons. The kernel splits exactly as $c = c_{\text{arch}} - c_{\text{comb}}$, $c_{\text{comb}} \geq 0$, and the archimedean section alone has *all* off-diagonals ≤ 0 on 20/20 windows, so every positive off-diagonal is comb-generated; all 20555 positive edges have their Hankel index inside the atom-hat index set (per-window fraction exactly 1.000000), so the support is a union of anti-diagonal stripes at prime-power atoms, each a perfect matching with exactly orthogonal edge vectors; the amplitude certificate $\Delta_{rt} \leq c_{\text{comb}}[M - 1 - r - t]$ holds on every edge (sharpest 0.99998532) while the Toeplitz lag fails on 20415. The Green function of the lumped comparison is bracketed entrywise from below by the Neumann partial sum *because the discarded terms are nonnegative* and from above by the anchor-weighted tail. And one *death certificate*: since Gershgorin, all row-sum norms and all Collatz–Wielandt quotients at positive weights are upper bounds for $\rho(|E|)$, the single lower bound $\rho(|E|) \geq 1.3141 \geq 1$ on 20/20 rows kills the whole absolute-value envelope family — while the *signed* $\rho(E) = \lambda_{\max}(W) \leq 0.99995781$. **Named limits as content:** per instance on small windows, no decay law and no amplitude law; the support statement is one inclusion; the structure bound assembled from it does not beat the margin (0 of 35 windows in T137) and is not promoted. Gershgorin 1931 / Neumann series named classical; Demko–Moss–Smith 1984 cited and *not* applied (the comparison is dense). [E] + [X] (one family closed; no marker moves)

The Hardy-core identities (PRIME.HARDY.IDENT.01). The identity blocks of T140 and T141 as the third companion module ([verification/v545_hardy_core_identities.py]; 36 checks, ~ 1 s) on 11 frame-A windows ($n = 8 \dots 139$, $h = 58 \dots 285 \leq 300$, D spanning a factor 3.15). With $C = \text{diag}(\sqrt{\Delta})M$ the weighted edge–interval incidence, $\text{Gram} = CHC^T$ (3.0×10^{-15}), so the signed Gram has rank $\leq h - 1$; the covering kernel in closed geometric form $K_{rs} = W([r \wedge s, r \vee s])$ equals $M^T \Delta M$ (1.3×10^{-15}), and $\rho(W) = \lambda_{\max}(K^{1/2} H K^{1/2})$ is an exact eigenvalue confirmed by three independent routes (5.4×10^{-14} , 7.8×10^{-16}), with $H = \text{diag}(s) + L_N$ (4.7×10^{-16}). Four identities put the residue in classical two-weight shape: the K^+ Rayleigh form (6.6×10^{-13}), the signed crossing kernel $L_N = D^T B D$ (4.9×10^{-16}), $Q = B_+ \mathbf{1}$ (1.4×10^{-15}) and $DKD^T = L_\Delta$ on the interior nodes (2.7×10^{-14}), whose diagonal is the endpoint edge mass; the crossing kernel of $|N|$ does not reproduce L_N , so the signs are load-bearing. The closed Muckenhoupt quantity $A_{M0} = \max_k Q_k(\Delta \mathbf{1})_{k+1}$ agrees on two routes (8.3×10^{-15}) and its size is reported, not promoted; the checkerboard split is entrywise exact with three dominating Weyl steps. Both certified shapes — the additive Hardy chain and the joint $\Lambda(H, Y) \cdot \Omega(Y)$ — are *valid* upper bounds on 11/11 windows, and only that validity is promoted. One *negative typing*: the exactly bounded object spreads $1.36\times$ over the D range while every absolute variant spreads $\geq 54.94\times$. **Named limits as content:** per instance on small windows, nothing uniform in the zone index or in D ; all exponents are fits; neither shape beats the target, and the zone-uniform discrete Hardy inequality stays open. Abel summation / Cauchy–Schwarz / Weyl 1912 / Gershgorin 1931 / Muckenhoupt 1972 / Opic–Kufner 1990 / Gantmacher–Krein named classical. [E] + [X] (one route typed; no marker moves)

The capacity-chain identities (PRIME.CAPCHAIN.IDENT.01). The identity spine of the capacity cycle T142–T145 as the fourth companion module ([verification/v546_capacity_chain_identities.py]; 26 checks, ~ 0.5 s) on 12 frame-A windows ($n = 4 \dots 139$, $h = 26 \dots 285 \leq 300$; covering kernel positive definite on 11). The capacity decomposition $K^{-1} = D^T J^{-1} D + xx^T/\text{cap}$ is a matrix identity (1.4×10^{-13} ; $J = DKD^T$ entrywise 3.8×10^{-15}) whose Dirichlet half is an orthogonal

projection under the congruence — $\Omega = 1$ exactly (5.1×10^{-12}), where T141 had guessed 20.7–2724; the exact capacity–Rayleigh identity for $1 - \rho(W)$ assembles against the direct quotient for every v (9.5×10^{-14}) and reproduces the eigenvalue under the declared 1/gap conditioning; $\text{cap}_E([a, a+j])$ is a prefix sum of one forward substitution (3404 interval capacities at 2.0×10^{-14} , exhaustive on the median window, the reversed ordering failing at $\geq 4.6 \times 10^{-1}$); the whitening certificate $\kappa_{\text{up}} = 1.2245\text{--}1.4236$ sits under the Gershgorin ceiling 2.1213, direction-correct; and the T145 M4 split — the pointwise mass-half theorem, $\sigma_{\text{tot}} = 0.2197\text{--}0.4425 < 1$ per window, licence 4 with $|R|$ and its built-in witness $[[1, -\frac{1}{2}], [-\frac{1}{2}, 1]]$ ($3 > 2$), the ordered sign-free chain — certifies S1' per window on both routes (better route $c_0 = 2.5154\text{--}4.2265$ against the Dirichlet value 4), with Charikar's cited density constant bracketed by exhaustive enumeration of all 4095 subsets of a small block. **Named limits as content:** per instance on small windows, nothing uniform in the zone index or in D ; the c_0 is measured at the minimiser's own layer cake and the a-priori level lemma (T145's L1) stays open; Maz'ya's strong-type half is not used as a theorem anywhere. Maz'ya 1985 / Muckenhoupt 1972 / Fukushima–Ōshima–Takeda 1994 / Miclo 1999 / Charikar 2000 / Goldberg 1984 named classical. [E] (per-instance identities and certified inequalities; no marker moves)

The level-lemma identities (PRIME.LEVEL.LEMMA.01). The a-priori core of T146 as the fifth companion module ([verification/v547_level_lemma_identities.py]; 20 checks, ~ 0.4 s) on 12 frame-A windows ($n = 4 \dots 139$, $m = 26 \dots 285 \leq 300$), 9 random positive definite forms and a stress ladder $m = 64 \dots 288$ — the a-priori side of the constant the capacity-chain module certified with a *measured* input. The union identity for nested cakes $\sum_{j,l} c_j c_l |S_j \cup S_l| = 2T \|\psi_t\|_1 - \|\psi_t\|^2$ is exact (0.0) against the $K \times K$ double sum and against union sizes computed with no nestedness used (controls $3.2 \times 10^{-2} / 4.8 \times 10^{-3}$); the counting lemma $G(b) \leq 2b^2 \|v\|_\infty \|v\|_1 / \|v\|^2 + \varepsilon$ holds for any vector at all 6 preregistered bases (the classical dyadic 8 at $b = 2$ exactly, the base free, gain 3.7612; the one-level-down cake breaks the domination on every draw); the resolvent delocalisation bound $\psi = \lambda R \psi \Rightarrow \|\psi\|_\infty \leq \lambda_{\text{up}} \max_j \|Re_j\|$ holds within 1.061–1.337 of the truth with Rayleigh–Ritz λ_{up} and residual-paid certified column norms — the columns sitting 2.85–10.17 below the trivial ceiling, $\Gamma = 1.8356\text{--}2.2797$, no Davis–Kahan step anywhere; and the composite level lemma $c_0^{\text{ap}} = 2b^2 \Gamma \min(1, \Gamma_1) + \varepsilon = 3.9042\text{--}4.8488$ certifies $\text{cert_lam_max}(R) \leq c_0^{\text{ap}} \Psi_{\text{abs}}$ on 12/12 windows (chain loss 0.0423–0.1272 of the exact gap), with the built-in no-go discriminator (Γ grows $3.676 \rightarrow 6.798$, $c_0^{\text{ap}} = 11.10$ exceeds every window value) and the flat Dirichlet control (1.0063). **Named limits as content:** per instance on small windows, nothing uniform in the zone index or in D , and explicitly no statement for all D — the asymptotic delocalisation of the Green columns stays open, typed open; the energy-route σ_{tot} stays measured. Maz'ya 1985 / Rayleigh–Ritz / Miclo 1999 / Davis–Kahan 1970 (cited, deliberately not used) / Charikar 2000 / Goldberg 1984 named classical. [E] (per-instance identities and certified inequalities; no marker moves)

The Green/Szegő identities (PRIME.GREEN.SZEGO.IDENT.01). The identity/certificate core of T147+T148 as the sixth companion module ([verification/v548_green_szego_identities.py]; 21 checks, ~ 0.4 s) on 12 frame-A windows ($n = 4 \dots 139$, $m = 26 \dots 285 \leq 300$), 7 random positive definite forms and a weight-class model ladder $m = 64 \dots 288$ — the two scalars the level-lemma constant is made of, certified. The factorisation identity $\Gamma = \sqrt{m} \lambda_{\text{up}} \max_j \|Re_j\| = \sqrt{Q^*} \cdot S_w$ ($S_w = \lambda_{\text{up}} \|R\|_F$ spectral, $Q^* = m \max_j (R^2)_{jj} / \text{tr}(R^2)$ geometric) is exact at 2.2×10^{-16} on all windows and random forms, the certified factorisation dominating everywhere ($S_w = 1.1186\text{--}1.5777$, $Q^* = 2.0879\text{--}2.8634$); the bottom-block trace identity $\sum_j (\Pi_B)_{jj} = |B|$ is exact (3.3×10^{-16} , $\theta = 10$, $|B| = 3\text{--}5$) with the measured equidistribution $Q_B/|B| = 1.5091\text{--}1.7980$ inside the preregistered $[1, 2.2]$ against the Szegő/Widom reference $2|B|$ (coordinate-projector control overshoots ≥ 3.9); the second-difference ℓ^1 ceiling $|a_k| \leq \min(1, \|s_k\|_\infty \|L_0^p \psi\|_1 / \mu_k^p)$ holds against the true coefficients everywhere with the m -free closed form $\|a\|_1 \leq 2\sqrt{\nu} + 1$ and the Dirichlet calibration $\|a\|_1 = 1$ exact, $\nu \rightarrow \pi$; the layer-cake S_w certificate from completed LDL^T inertia counts (inertia = direct count on all 96 rungs) gives $S_w \leq 1.3288\text{--}1.8220$ (true 1.1186–1.5777, the bottom-layer drop breaking it everywhere); and the Liouville transform $m \|\psi\|_\infty^2 \leq 2\kappa_\Lambda \text{ceil}(\hat{\varphi})^2$ ($\varphi = \Lambda^{-1/2} \psi$, a-priori $\kappa_\Lambda = 1.3868\text{--}2.5805$) holds stepwise, with the weight-class discriminator at matched κ_Λ (mismatch

0.0013): BV flat (1.003) versus rough growing 19.9 (TV split 162.6) — the roughness, not the conditioning. **Named limits as content:** per instance on small windows, nothing uniform in the zone index or in D , and explicitly no statement for all D — the one open lifting input ($\nu_L \leq F(\text{form})$ m -free / bounded $\text{TV}(\log \Lambda)$) stays open, typed open; the symbol-level order-2 hypothesis is refuted ($f(0) < 0$ on every surface window) and enters nowhere as a theorem; σ_{tot} stays retired as a route. KMS 1953 / Widom 1958 / Basor–Ehrhardt 2009 / Sylvester 1852–Bunch–Kaufman 1977 / Euler 1735 / Davis–Kahan 1970 (cited, computed vacuous, not used) named classical. [E] (per-instance identities and certified inequalities; no marker moves)

The gauge/parity identities (PRIME.GAUGE.PARITY.IDENT.01). The identity/certificate core of T149+T150 as the seventh companion module ([`verification/v549_gauge_parity_identities.py`]; 21 checks, ~ 0.3 s) on 12 frame-A windows ($n = 4 \dots 139$, $m = 26 \dots 285 \leq 300$), 48 gauge assemblies, the full-section parity items on the 6 windows with $M \leq 300$, and a parity control model at $m = 2001$ — the gauge freedom around the Green/Szegő machinery and the parity structure underneath it, certified. For any positive diagonal $\tilde{\Lambda}$ the chain $\lambda_{\min}(A) \geq \text{cert } \lambda_{\min}(\tilde{E}) \cdot \min_j \tilde{\Lambda}_j$ is a valid certified lower bound (identity plus one Rayleigh step; family maximum valid), $\Gamma = \sqrt{Q^*} S_w$ holds gauge-invariantly at 2.4×10^{-16} , and the const gauge has $\text{TV}(\log \tilde{\Lambda}) = 0$ exactly with certified sandwich $\sigma = 1.3868\text{--}2.5805$ (the completed-Cholesky floor refusing on the shifted indefinite form, 12/12); the two-regime discriminator: the flutter smoother removes TV by $\geq 2.88\times$ while the Liouville-transported ν_L moves ≤ 0.0088 (rough re-gauge ≤ 0.0046), the untransported functional jumping 0.41–9.76 under the same rough gauge — the roughness is in the form, not the multiplier; the explicit zone diagonal $\Lambda_r = c_0 - c_{M-1-2r} + \sum_{s \neq r} \max(c_{|r-s|} - c_{M-1-r-s}, 0)$ at 5.9×10^{-16} with the exact split $c = c^{\text{arch}} + c^{\text{atom}}$ ($c^{\text{atom}} \leq 0$) and the closed atom budget $\|c^{\text{atom}}\|_1 \leq 4B\sqrt{N}$ ($B = 1.038821$ verified on the table), the archimedean section itself indefinite on 12/12 — the atoms co-responsible for the positivity, the additive perturbation reading structurally empty; the parity compression $U_-^T T_M(c) U_- = T - H$ exact (cross block 1.4×10^{-16}) with the negative inertia of the sign-changing symbol localised entirely in the *even* sector (odd sector zero, LDL^T) — $f(0) < 0$ explained rather than worked around; and the parity-sine calibration $\nu_k^P = \pi k^2$ on the exact model (3.0×10^{-5}) with the per-window ladder $\nu_k^P \leq Ck^2$, certified $C = 11.70\text{--}17.28$. **Named limits as content:** per instance on small windows, nothing uniform in the zone index or in D , and explicitly no statement for all D — the one open input (an m -free C in the odd-sector ladder for a sign-changing symbol) stays open, typed open; $\text{TV}(\log \Lambda)$ stays withdrawn as a hypothesis; σ_{tot} stays retired as a route. KMS 1953 (parity sector) / Widom 1958 / Basor–Ehrhardt 2009 (the sign-changing symbol is exactly what it does not cover) / Sylvester 1852–Bunch–Kaufman 1977 / Chebyshev 1852 (verified on the table) / Abel / Weyl 1912–Bauer–Fike 1960–Davis–Kahan 1970 (cited, computed dead, not used) named classical. [E] (per-instance identities and certified inequalities; no marker moves)

The odd-sector identities (PRIME.ODD.SECTOR.IDENT.01). The identity/certificate core of T151 as the eighth companion module ([`verification/v550_odd_sector_identities.py`]; 19 checks, ~ 0.2 s) on 12 frame-A windows ($n = 4 \dots 139$, $m = 26 \dots 285 \leq 300$), parity control models at $m = 241$ and $m = 2001$, and a no-go size ladder $m = 64 \dots 256$ — the reroute off the quadratic ladder, certified: the grid step-over ($\mu_k^P = 2 - 2 \cos \theta_k$ exact on the shifted grid $\theta_k = 2\pi k/N$; the symbol's negative window satisfies $\theta_c/\theta_1 = 0.371\text{--}0.485$ on every window — odd-sector positivity is a grid fact, with the symbol-only floor certified vacuous on 12/12: the local model is a matrix statement, not a symbol one); the certified bottom ladder $\lambda_k(A) \leq S\mu_k^P$ for $k \leq 8$ by completed LDL^T counts ($S = 1.1019\text{--}6.4725$, $f(0) < 0$ absorbed by the Rayleigh floor); the discrete Sobolev step $\|\psi\|_\infty^2 \leq 2\|\psi\|_2 \|\nabla \psi\|_2$ licensed by the odd sector's virtual node, with the model pencil $(1, 1)$ certified and the per-mode price exactly π (5.1×10^{-8}); the closed archimedean minimum $\min_r \Lambda_r^{\text{arch}} = c_0^{\text{arch}} - c_{M-1}^{\text{arch}}$ exact and attained (residual 0.0); and the linear per-mode bound $b_k = 2m\sqrt{K_{\text{bot}}\mu_k^P/\kappa} \leq C_S k$ with certified $\kappa = 0.1939\text{--}0.3599$ and $C_S = 12.081\text{--}26.953 \leq 2\pi\sqrt{K_{\text{bot}}/\kappa}$ — linear where the quadratic ladder grew, the T145 no-go's bottom pencil ratio exploding $\times 15.8$ while the parity model holds 1. **Named limits as content:** per instance on small windows, nothing uniform in the zone index or in D , and

explicitly no statement for all D — the one open input (the m -freeness of the bottom pencil ratio $R = K_{\text{bot}}/\kappa = 3.7362\text{--}18.6607$) stays open, typed open; the symbol route stays certified vacuous. KMS 1953 / Widom 1958–Basor–Ehrhardt 2009 (the computed answer: the pointwise symbol language does not extend to the bottom mode) / Weyl 1912 / Parlett / Hardy–Littlewood–Pólya 1934–Agmon 1965 / Sylvester 1852–Bunch–Kaufman 1977 / Chebyshev 1852 named classical. [E] (per-instance identities and certified inequalities; no marker moves)

The fixed-size Ritz ceiling certificate (PRIME.RITZ.CEIL.01). The certificate core of T154 as the ninth companion module ([`verification/v551_ritz_ceiling_certificate.py`]; 16 checks, ~ 0.4 s) on the 12 deepest in-cap frame-A windows ($n = 29 \dots 139$, $m = 96 \dots 291 \leq 300$; a no-go size ladder $m = 48 \dots 288$; parity controls $m = 64 \dots 256$; 3 Dirichlet control windows) — the fixed-size replacement for the ceiling step, certified: the direction lemma ($\lambda_k(A) \leq \theta_k$ for every $k \leq \dim$ — Ritz values are upper bounds of the same-index eigenvalues, Courant–Fischer 1920 / Cauchy 1829, verified against exact spectra; the reversed reading refuted on 12/12 — so the ceiling needs no residual argument); the sixteen-column certificate $\text{span}\{t_1..t_8\} + A^{-1}L_P \text{span}\{t_1..t_8\}$ (dimension 16 fixed, independent of m ; 8 completed Choleskys $\leq 8 \times 8$) with $K^F = 1.1019\text{--}1.5845$ attaining the inertia-certified K_{bot} to $\leq 9.9 \times 10^{-7}$ against the declared cap 10^{-4} on 12/12 — the size- m LDL^T counts retired from the ceiling step (sines alone overshoot 41.6–739; corrupted Green columns break the attainment); the one-direction anatomy (median of the seven aligned angles $0.03\text{--}0.14^\circ$ against the largest $83.79\text{--}89.70^\circ$; the collapse price $\lambda_1(A)/(t\mu_1^P) = 4.408\text{--}7.042$ recovered in full per window by one Cholesky, size m , labelled as such); and the no-go discriminator (the floor survives at $t = 0.05$ while K_{bot} explodes $\times 35.4$ and the ceiling with it $\times 57.5$; the Dirichlet control certified non-positive on 3/3 — the reflection half is load-bearing for positivity). **Named limits as content:** per instance on small windows, nothing uniform in the zone index or in D , and explicitly no statement for all D — the attainment is not promoted to a theorem (the no-go overshoots), and the two open inputs after T154 (R1' the m -free block floor, R2' the m -free bottom-mode floor on the Ritz complement, arithmetic-free and worth 91–100% of the price) stay open, typed open. Courant–Fischer 1920–Cauchy 1829 / KMS 1953 / Schur 1917–Haynsworth 1968 / Sylvester 1852–Bunch–Kaufman 1977 / Temple 1928–Kato 1949 (a floor device, not used here) / Kaniel 1966–Paige 1971 (quoted, never a bound) / Björck–Golub 1973 named classical. [E] (per-instance theorems and certified inequalities; no marker moves)

The four fixed-size angle instruments (PRIME.ANGLE.INSTR.01). The instrument cores of T155 and T157 as the tenth companion module ([`verification/v552_angle_instruments.py`]; 18 checks, ~ 0.4 s) on the same declared surface (the 12 deepest in-cap frame-A windows, $n = 29 \dots 139$, $m = 96 \dots 291 \leq 300$; no-go ladder $m = 48 \dots 288$; parity and Dirichlet controls at $m = 64, 128, 256$) — none of the four closes an angle: the 12×12 complement-floor certificate ($\min_{v \perp W} v^T L_P v \geq \mu_{13}^P - \lambda_{\max}(M^{1/2}(I - GG^T)M^{1/2})$, an identity plus one certified Rayleigh bound; never above the exact complement bottom, agreement $\leq 1.01 \times 10^{-3}$ against the declared cap 2×10^{-3} on this surface, both closed-form controls to 2.0×10^{-11} including the worthless configuration); the sine-block confinement ($\|\gamma_H\|^2 \leq (S/t)/\rho_{17} = 0.0153\text{--}0.0245$ from the certified floor and ladder alone — the bottom eigenvector is 97.5–98.5% inside the first 16 parity sines by a per-instance theorem; κ in place of S : vacuous, 17.6–477); the Schur-entry identity ($s = \mu_1^P t_1^T A^{-1} t_1 = (B^{-1})_{11}$ to 1.1×10^{-11} , $(B^{-1})_{LL} S_L = I$ to 5.8×10^{-11} — $1/s = 4.0460\text{--}5.8962$ is an $O(1)$ number carried by one entry of the fixed-size 16×16 Schur complement, while the inversion-free Cauchy–Schwarz ceiling misses by $250\text{--}7.27 \times 10^3$); and the adaptive Lipschitz ceiling (an *executed* certificate $\inf f^{\text{arch}}/(4 \sin^2(\theta/2)) \geq 0.25$ on 12/12 in 519–1201 evaluations, refusing false targets on 12/12). The no-go floor survives while the confinement goes vacuous ($\times 52.0$) and $(S_L)_{11}$ explodes ($\times 60.0$); parity exact to 4.9×10^{-14} ; Dirichlet hits $2/\sqrt{N}$ to 7.4×10^{-5} . **Named limits as content:** per instance on small windows, nothing uniform in the zone index or in D , and explicitly no statement for all D — nothing about the angles is closed; the two open terms after T157 (an m -free upper bound on the one Schur diagonal entry; an m -free R1'' domination with a non-shrinking margin) stay open, typed open. KMS 1953 / Schur 1917–Haynsworth 1968 / Cauchy–Schwarz (refuted as a ceiling, wired as a control) / Kantorovich 1948 / Sylvester 1852–Bunch–Kaufman 1977 / Szegő

1915–Widom 1958 (a named address, never a licence) named classical. [E] (per-instance identities and certified inequalities; no marker moves)

The exact-form identities (PRIME.EXACT.FORM.IDENT.01). The theorem cores of T158 and T159 as the eleventh companion module ([verification/v553_exact_form_identities.py]; 25 checks, ~ 0.2 s) on the same declared surface (12 deepest in-cap frame-A windows, $m = 96 \dots 291 \leq 300$; no-go ladders $m = 48 \dots 288$ on both T145 forms; parity and Dirichlet controls at $m = 64, 128, 256$) — the algebra of the sixteen-form itself, closing neither open term: the Thomson dual form $s = (B^{-1})_{11} = \max_x (2x_1 - x^\top Bx)$ with the direction *executed* and the positive Cholesky ladder tight to 1.0642–1.1522 (a 5% corruption makes the Cholesky refuse); the two-dimensionality $\text{span}\{t_1, A^{-1}L_P t_1\}$ attaining s to 9.0×10^{-13} (KMS 1953); the gauge identity $\sum_d w_d = 0$ *entrywise-exact* in its mechanism ($\text{odd_toeplitz}(\mathbf{1}) = 0$, zero tolerance — the form is blind to the lag mass, exactly where the h^2 halves cancel) with the Toeplitz-minus-Hankel signature to 1.4×10^{-16} ; the exact lag sum $x^\top B_{LL}x = \sum_d c_d w_d$ to 2.7×10^{-16} of the absolute scale (relative to the cancelled total only 1.4×10^{-11} — the honest price, measured) with the two closed scalars $w_0 = \sum_k x_k^2 / \mu_k^P$ and $2w_0 - w_1 = \|x\|^2$ exact; and the Z-matrix law — B_{HH}^{arch} symmetric Z-matrix *raw* on 12/12 with the closed sign-based Collatz–Wielandt floor $0.9093\text{--}1.1284 \geq 0.25$ verified against the exact $\lambda_{\min} = 0.9138\text{--}1.1432$, while the atom block obeys no sign law (a coin toss) and the full-block criterion is vacuous. The T145 no-go breaks on three axes; on the $c(l) = 1/(1+l)$ reconstruction the ladder theorem survives while $1/g_{16}$ explodes ($1187 \rightarrow 7.11 \times 10^4$); parity control: for $A = L_P$ the full machinery returns $s = 1$ with every ladder partial sum constant in K . **Named limits as content:** per instance on small windows, nothing uniform in the zone index or in D , and explicitly no statement for all D — the two open terms after T159 (the one explicit pairing inequality for $R2''$, needing correlation instead of sizes; a third device for the atom off-band block for $R1''$) stay open, typed open. Maz’ya 1985 / Miclo 1999 / Schur 1917–Haynsworth 1968 / KMS 1953 / Dirichlet 1829 / Perron 1907–Frobenius 1912 / Collatz 1942–Wielandt 1950 / Gantmacher–Krein 1950 named classical. [E] (per-instance identities and certified inequalities; no marker moves)

The sampling/harmonics identities (PRIME.SAMPLING.HARM.01). The closed theorem cores of T160 and T161 as the twelfth companion module (21 checks, ~ 0.5 s) on the same declared surface (12 deepest in-cap frame-A windows, $m = 96 \dots 291 \leq 300$) plus a declared Λ -battery of six log-spaced cut-offs $X = 10^3 \dots 3.2 \times 10^5$ (finite von-Mangoldt sums only, no matrix anywhere) — what the sixteen-form *pairs against*, closing no open term: the sampling identity — the atom half of the pairing equals $-\frac{1}{2} \sum_{n \leq X} (2\Lambda(n)/\sqrt{n}) \hat{w}(\log n)$ to 5.6×10^{-15} of the absolute atom scale on 12/12, identically a finite combination of sums $\sum_n \Lambda(n) n^{-1/2} \cos(t \log n)$ at 32 explicit frequencies; the closed moment laws $m_0 = 0$, $m_1 = -[S_0^2 + 2 \sum_j P_j^2] \leq 0$, $m_2 = -[2S_1 - (M-1)S_0]^2 \leq 0$ (both strictly negative) with the total-variation theorem from *checked* hypotheses, $\text{TV}(c^{\text{arch}}) \leq |c_0| + 2 \sup < 6$ closed and window-independent; the harmonic-frequency theorem $t_j(2\alpha) = 2\pi j$ *exactly* — the 32 frequencies are the Fourier harmonics of the log-window — with the closed parameter-free PNT prediction $(\sqrt{X} - 1)/(\frac{1}{4} + t^2)$ matching the finite sums to 0.0007–0.097 of the trivial mass against the declared cap 0.12 (wrong-pole and fake-measure mutations fail loudly); the head split $c_d^{\text{arch}} = \Psi_d + D\hat{G}(dD, D)$ with $\Psi_d = -\frac{1}{2}[(d+1)\log(d+1) - 2d\log d + (d-1)\log(d-1)]$ closed, D -free and m -free, exact to 3.2×10^{-16} at every lag, plus the scale-free Bernstein rate $\rho^* = (3 + \sqrt{5})/2 = 2.618034$; and the certified off-diagonal fraction bound $|\text{off}| \leq \frac{1}{4}|Q^{\text{arch}}|$ (0.171–0.212 on 12/12) with the *refuted* sign law wired as the negative control (arch half negative, off-diagonal block positive, 176/240 pairs violate) — nothing single-signed promoted. The head split misses the T145 no-go reconstruction by 2.39; the Dirichlet cosine-sum and KMS controls are exact. **Named limits as content:** per instance on small windows, nothing uniform in the zone index or in D ; finite Λ -sums allowed and used, *no* RH statement, the δ triage of T161 a documentation item and not a module claim — the open terms after T161 (R-A’ the prime-free log-moment; R-B’ the m -free 16×16 Gram fraction bound; R-C’ one split with $\delta_{\text{eff}} < \frac{1}{2}$; R-D a fifth $R1''$ device) stay open, typed open. Dirichlet 1829 / Abel 1826 / Fejér 1915–Schur 1917 / Bernstein 1912 / Chebyshev 1852–Mertens 1874 / de la Vallée Poussin 1896 / Clausen–Lerch / KMS 1953 named classical.

Machine-checked: [verification/v554_sampling_harmonics_identities.py]. [E] (per-instance identities and certified inequalities; no marker moves)

The Pareto/total-variation identities (PRIME.PARETO.TV.01). The closed theorem cores of T162 and T163 as the thirteenth companion module (23 checks, ~ 0.4 s) on the same declared surface (12 deepest in-cap frame-A windows, $m = 96 \dots 291 \leq 300$), with the one arithmetic input $\kappa = 0.038821$ *verified* at every jump point of $\psi(x)/x$ on the von-Mangoldt table — the *price structure* of the pairing, closing no open term beyond the negative closure the floor inequality itself is: the exchange law $\delta_{\text{bnd}}(x) = \frac{1}{2} + \log(2\kappa g_{16} \text{TV}(x)/P(x))/\log X$ as an identity at all 612 grid points of the declared Fejér knob (5.1×10^{-16}), the crossing criterion $\delta_{\text{bnd}} < \frac{1}{2} \iff P > 2\kappa g_{16} \text{TV}$ an exact equivalence at every point — price and demand two coordinates of one object; the total-variation floor $w_0 = \|a\|^2$, $\text{TV} \geq |w_0|$ (telescoping, $w_M = 0$), $x_1 = 1 \Rightarrow \mu_1^P \text{TV} = 5.00\text{--}28.84 \geq 1$ on all 708 trial vectors, the closed floor $1/(4\sin^2(\pi/N)) \sim h^2$, hence every sub- $\frac{1}{2}$ point pays $P > 2\kappa g_{16}/\mu_1^P = 15.4\text{--}142.8$ — a flat-price sub- $\frac{1}{2}$ demand is impossible in the parity sector on this surface (R-C''' closed negatively), the inadmissible vector undercutting the floor as the wired negative control; the chain-derived price axis ($\sigma = 1$ exactly the $K = 1$ rung, 4.1×10^{-16} ; $\sigma = \infty$ the $K = 16$ top rung, 1.2×10^{-12} ; the knob monotone in both coordinates — its curve *is* the Pareto front; a corrupted sixteen-block makes the Cholesky refuse); the closed Mellin cell moments $C_d(-(2k + \frac{1}{2}))$ against an independent quadrature (2.8×10^{-13} , $k = 1 \dots 4$) and the boundary-free Abel step at levels 1–3 (8.3×10^{-17}) with the closed loss reason $32\pi/\alpha = 40.6\text{--}59.4 > 1$ and the gauge break equal to its closed prediction (1.2×10^{-15}); and the Lerch/Frullani log-moment on three routes (Wronskian form 2.8×10^{-14} , integral with the $d = 1$ peel 1.8×10^{-15} , $2\log 2$ to 2.2×10^{-16} , $\Psi_1 = -\log 2$ exact), plus the monotone no-go staircase ($1.00 \rightarrow 3.49 \rightarrow 10.81 \rightarrow 24.98$, exact null control) and exact Dirichlet/parity controls. **Named limits as content:** per instance on small windows, nothing uniform in the zone index or in D ; the T163 h -exponents are sandbox fits, *not* consumed; finite Λ -sums allowed and used, *no* RH statement — the open terms after T163 (R-E the successor, both arms prime-free: a growing $1/s$ ceiling for the downstream chain, or a sector whose gap does not vanish like h^{-2} ; R-B''' the h -uniform positivity margin; R-D a fifth R1'' device) stay open, typed open. Fejér 1915 / Mellin 1896 / Abel 1826 / Chebyshev 1852–Rosser–Schoenfeld 1962 / Legendre / Dirichlet 1829 / KMS 1953 / Frullani 1828–Lerch 1887–Clausen 1832 / Schur 1917–Haynsworth 1968 named classical. Machine-checked: [verification/v555_pareto_tv_identities.py]. [E] (per-instance identities and certified inequalities; no marker moves)

The gauge/ P_{pr} identities (PRIME.GAUGE.PPR.01). The closed theorem cores of T164 and T165 as the fourteenth companion module (23 checks, ~ 0.3 s) on the same declared surface (12 deepest in-cap frame-A windows, $m = 96 \dots 291 \leq 300$), with the one arithmetic input $\kappa = 0.038821$ *verified* at every jump point of $\psi(x)/x$ on the von-Mangoldt table — the *gauge structure* of the pairing, not closing the one remaining quantifier: the gauge theorem — $x_1 = 1$ fixes only the scale of a , Q and TV are homogeneous of degree two, so the demand ratio Q/TV of the same a -direction is the same number in *every* sector, unchanged to 2.9×10^{-11} on 2520 sector-by-trial-vector combinations, with the pure shift scaling the certified value by exactly $\theta = \mu_1^P/(\mu_1^P + \kappa_s)$ and the full space settled strictly worse ($\mu_0 = 0$ exactly; the wrong transport map breaks by $2.0 \times 10^2\text{--}5.4 \times 10^3$); the h^2 conservation law floor $\times$ transfer $= 1/\mu_1^P$ *identically* at every shift (2.2×10^{-16} ; the wrong transfer misses by 0.9995); the power-one spend as an identity, $d \log r / d \log U = +1$ exactly (1.1×10^{-14} ; the quadratic consumption reads 2); the P_{pr} identity $P_{\text{pr}} = g_{16} \cdot R \cdot (\text{TV}/(t_1 v)^2)/\mu_1^P$ exact to 4.3×10^{-16} on all 192 battery vectors with the predicate equivalence exact everywhere and every crossing vector paying $P_{\text{pr}} > 2\kappa g_{16}/\mu_1^P = 15.4\text{--}142.8$ above the preregistered tolerance 10 on 12/12 — the successor question R-F closed negatively by an identity plus a floor (the $(t_1 v)$ -unsquared mutation breaks the gauge invariance loudly); and the Schur-cascade direction $s \geq g_{16} \geq g_1$ with $P_K = \hat{a} s \geq 1$ (Kantorovich 1948) and the exact exponent closure of the lists (1.3×10^{-15} ; the g_8 closure breaks by 0.10–0.24, a corrupted sixteen-block makes the Cholesky refuse), plus the monotone no-go staircase ($1.00 \rightarrow 3.49 \rightarrow 10.81 \rightarrow 24.98$, exact null control) and exact Dirichlet/parity controls. **Named limits as content:** per instance on small windows, nothing uniform in the zone index or in D ; the T164/T165 h -exponents and the measured anatomy (the free

ascent, the $\eta(\text{Cap})$ profile, the decoupled ν surface, the retired constant $U_{\text{ref}} = 4.90 \rightarrow 5.7327$) stay sandbox, *not* consumed; finite Λ -sums allowed and used, *no* RH statement — the one open object after T165 ($\inf_m g_{16}(m) > 0$, equivalently a lower bound on the sixteen-step Schur-cascade gain g_{16}/g_1 uniform in m — a quantifier over a certified flat list) stays open, typed open; R-B''' open as narrowed. Schur 1917–Haynsworth 1968 / KMS 1953 / Abel 1826 / Chebyshev 1852–Rosser–Schoenfeld 1962 / Kantorovich 1948 / Fejér 1915 / Dirichlet 1829 named classical. Machine-checked: [verification/v556_gauge_ppr_identities.py]. [E] (per-instance identities and certified inequalities; no marker moves)

The cascade/vector identities (PRIME.CASCADE.VECT.01). The closed theorem cores of T166 and T167 as the fifteenth companion module (23 checks, ~ 0.1 s) on the same declared surface (12 deepest in-cap frame-A windows, $m = 96 \dots 291 \leq 300$), with the one arithmetic input $\kappa = 0.038821$ *verified* at every jump point of $\psi(x)/x$ on the von-Mangoldt table — the *anatomy of the cascade* and the *exactness of the closed vector at $K = 2$* , not closing the one remaining scalar: the cascade identities — the prefix property (one Cholesky, all sixteen rungs; 1.1×10^{-12} on 192 comparisons), the minor form $1/g_K = \det G_{[1..K]}/(\mu_1^P \det G_{[2..K]})$ on the raw arithmetic Gram block (2.7×10^{-12} ; Schur 1917–Haynsworth 1968) and the regression form $g_K/g_1 = 1/(1 - R_K^2)$ (8.8×10^{-13} ; the wrong minor misses by 0.99–1.45); the diagonal invariance of the gain under $B \rightarrow DBD$ (2.7×10^{-12} on 144 random positive diagonals — the gain belongs to the arithmetic Gram block alone; a non-diagonal congruence moves it by 2.7–3.8); the exact $K = 2$ identity — the closed vector $(1, -Q_{21}/Q_{22})$ attains $1/g_2 = Q_{11}(1 - r_{12}^2)$ exactly (1.1×10^{-12}) and $B_{11}g_2 = 1/(1 - r_{12}^2)$ identically (1.2×10^{-12}): the fast-null-vector is free at $K = 2$, the third dress collapses onto the second (the wrong-sign vector pays $4r_{12}^2/(1 - r_{12}^2) = 6.7 \times 10^2$ – 1.5×10^4); the pivot identity $u^\top Q_K u = 1/g_K + \delta^\top Q_K \delta$ for $\delta_1 = 0$ (2.0×10^{-12} on 252 evaluations, every candidate excess an exact number; the $\delta_1 = 0.1$ mutation breaks by exactly the closed cross term $2\delta_1$) with the exact entry threshold (sign-aligned attainment 3.8×10^{-16}) and the unification $(1/g_2)/S_2 = (1 - r_{12}^2)/(1 + 3r_{12}^2)$ (1.2×10^{-12}) — one inequality, not three; and the trial theorem (288 random trials with $u_1 = 1$ all bound g_K from below, min ratio 15.14; Schur 1917) with the L_P no-go (cascade gain exactly 1, deviation 0.0) and the scramble type-change (B_{11} itself loses positivity on a majority of draws on 12/12 windows — a change of type, not a factor) as must-breaks, plus exact Dirichlet/parity controls. **Named limits as content:** per instance on small windows, nothing uniform in the zone index or in D ; the T166/T167 h -exponents ($1 - r_{12}^2 \sim h^{-2.921}$ on frame A, the certified gain exponent $h^{+2.921}$, the threshold monotonicity in K , the $K = 6$ separation $h^{+1.138}$) and the measured anatomy (the rung profile, the polarisation split, the Kato radius, the headroom) stay sandbox, *not* consumed; finite Λ -sums allowed and used, *no* RH statement — the one open object after T167 (R1, the single scalar: an m -free upper bound on $1 - r_{12}^2 = 1 - Q_{12}^2/(Q_{11}Q_{22}) \leq C h^{-3+\varepsilon}$, three closed lag sums and nothing else) stays open, typed open; the routes T167 closed off (perturbation theory of every order — the Kato series converges to the wrong object; position-blind surrogates) stay sandbox negatives; R-B''' open as narrowed. Schur 1917–Haynsworth 1968 / KMS 1953 / Rayleigh 1877–Courant–Fischer 1920 / Cauchy 1829 / Kato 1949 (cited as the closed-off route, never used) / Chebyshev 1852–Rosser–Schoenfeld 1962 / Dirichlet 1829 named classical. Machine-checked: [verification/v557_cascade_vector_identities.py]. [E] (per-instance identities and certified inequalities; no marker moves)

The bilinear/rank identities (PRIME.BILINEAR.RANK.01). The closed theorem cores of T168, T169 and T170 as the sixteenth companion module (27 checks, ~ 0.2 s) on the same declared surface (12 deepest in-cap frame-A windows, $m = 96 \dots 291 \leq 300$), with the one arithmetic input $\kappa = 0.038821$ *verified* at every jump point of $\psi(x)/x$ on the von-Mangoldt table — the *exact shape of the one remaining scalar*, not closing it: the Lagrange/Wronskian anatomy — the lag-sum identity $\hat{a}_{ij} = t_i^\top A_h t_j = \sum_d c_d W_d^{ij}$ (1.6×10^{-15}), Euclidean orthogonality $t_1 \cdot t_2 = 0$ (4.4×10^{-16} — the near-parallelism is created entirely by the arithmetic metric), the Wronskian telescope with closed window edge (1.9×10^{-17}) and $\frac{1}{2} \sum M^2 = 1/(\mu_1 \mu_2)$ exactly (Lagrange 1773); the exponent account $1 - r_{12}^2 = \nu_1 \nu_2 / (\hat{a}_{11} \hat{a}_{22})$ (2.5×10^{-13}) with the unconditional Gershgorin certificate $\nu_1 \leq \max(\hat{a}_{11}, \hat{a}_{22}) + |\hat{a}_{12}|$ (12/12, loss 1.19); the T169-TH7 det-collapse $R(K7) = 2\sqrt{\hat{a}_{11}\hat{a}_{22}} \det \hat{A}/[(\hat{a}_{11} + \hat{a}_{22})(\sqrt{\hat{a}_{11}\hat{a}_{22}} + \hat{a}_{12})]$ (8.7×10^{-13} — the loop closes as an identity) with

$\nu_2 \leq 2 \det \hat{A} / (\hat{a}_{11} + \hat{a}_{22})$ tight to < 2 exactly; the exact bilinear von Mangoldt form $\hat{A} = B - S$ (1.7×10^{-14}), $\det \hat{A} = \det B - D(B, S) + \det S$ (1.0×10^{-10}) and $\det S$ as an explicit double Λ -sum against the wedge kernel $K = \frac{1}{2}D(X_n, X_m)$ (7.5×10^{-16} ; Cauchy–Binet 1812–1815); the rank-3 theorem (polarisation-matrix eigenvalues $\{-2, -1, +1\}$, $\sigma_4/\sigma_1 \leq 1.6 \times 10^{-16}$: the form *is* $S_{11}S_{22} - S_{12}^2$ in three linear Λ -sums) with the Type II collapse (Vaughan coefficient-exact, kernel rank $[2, 2, 2, 2]$ against generic $[20, 15, 11, 9]$); and the R4-free chain identity (the Weil fence never approached) with the L_P no-go ($\hat{a}_{12} = 1.1 \times 10^{-17}$ identically) and the scramble discriminator (rank invariant on all 60 draws, value moves $\times 834.8$ median — the arithmetic sits in the joint values of (S_{11}, S_{22}, S_{12}) against B) as must-breaks, plus exact Dirichlet/parity controls. **Named limits as content:** per instance on small windows — nothing uniform in the zone index or in D ; the T168–T170 h -exponents and route-table deltas stay sandbox, *not* consumed; finite Λ -sums allowed and used, *no* RH statement — the one open object after T170 (R1, classified as a joint near-degeneracy of three explicit linear Λ -sums, not a size) stays open, typed open. Lagrange 1773 / Cauchy–Binet 1812–1815 / Gershgorin 1931 / Rayleigh 1877 / Montgomery–Vaughan 1973–Vaughan 1977 (the priced route) / KMS 1953 / Chebyshev 1852–Rosser–Schoenfeld 1962 / Dirichlet 1829 named classical. Machine-checked: `[verification/v558_bilinear_rank_identities.py]`. **[E]** (per-instance identities and certified inequalities; no marker moves)

The phase-2 capstone (PRIME.PHASE2.CAPSTONE.01). The capstone *verifies the map and claims nothing new*: the whole sixteen-link reduction chain of phase 2 — from the I5 floor to the R1 shape — as *one* machine-checked pass (35 checks, ~ 0.3 s) on the same declared surface (12 deepest in-cap frame-A windows, $m = 96 \dots 291 \leq 300$; $\kappa = 0.038821$ verified at every jump point; low block positive definite on 12/12, a numerical fact, never routed through the Weil criterion), 13 links THEOREM / 3 links CERT: the T152 Schur two-block criterion sharp at 0.5λ vs 1.02λ ; the T151 Sobolev bound (ratio 0.4816); the T153 Ψ -collapse with the Z-law (6.3×10^{-16} / 9.0×10^{-17}); the T154 Ritz ceiling from below ($g_{32}/s = 0.9520$ – 0.9849); the sharp T155 12×12 floor; the T156 $F(P, r)$ chain; the T158 Thomson/ladder duality (36/36 trials below); the T160 sampling identity; the T163 Abel swap with the TV floor; the T164 gauge/quantifier collapse $\Psi(x^*) = 1/g_{16}$; the T165 P_{pr} identity; the T166 cascade $1/(1 - R_{16}^2)$, diagonal-invariant; the T167 $K = 2$ exactness; the T169 det collapse, R4-free (no positivity of A_h consumed); the T170 rank-3 theorem ($\{-2, -1, +1\}$ exact); and the T170 R1 shape ($\sin \angle = 1.169 \times 10^{-4}$ – $2.467 \times 10^{-3} \leq 10^{-2}$ per window, rate and quantifier typed OPEN); plus the eight-route no-go battery failing exactly as classified (size budget, symbol infimum, sector invariance, perturbation scale, band-local, sieve operator norm, scramble $\times 679$ median with rank-3 untouched, L_P gain = 1) and the precision ledger (needed 2.752×10^{-4} , finer than the RH yardstick by $215\times$ and the best unconditional by $13\times$ on this surface; both self-similarity identities $\leq 6.8 \times 10^{-13}$), each load-bearing identity with a mutation control. **Named limits as content:** per instance on small windows — nothing uniform in the zone index or in D ; the T171 trend fits and full-surface numbers stay sandbox, *not* consumed; *zero* new uniform-in- m statements — which is exactly why the capstone is promotable; the one open phase-2 object (R1, the collinearity / near-degeneracy rate) stays open, typed open; *no* RH statement. Schur 1917–Haynsworth 1968 / KMS 1953 / Cauchy 1829–Courant–Fischer 1920 / Rayleigh 1877 / Abel 1826 / Dirichlet 1829 / Lagrange 1773 / Cauchy–Binet 1812–1815 / Kato 1949 / Montgomery–Vaughan 1973–Vaughan 1977 / Chebyshev 1852–Rosser–Schoenfeld 1962 / Fejér 1915 named classical; Weil 1952 / Bombieri 2000 cited, never a criterion. Machine-checked: `[verification/v559_phase2_capstone.py]`. **[E]** (per-instance identities and certified inequalities; no marker moves)

The frame/deficit identities (PRIME.FRAME.DEFICIT.01). The gauge route of phase 2, closed as algebra: the theorem cores of T172 (FRAME.BEYOND), T173 (FRAME.RATE) and T174 (CANCEL.IDENTITY) as *one* machine-checked module (24 checks, ~ 0.5 s) on a small declared surface (a 4×3 (anchor, h) rectangle of gap-blind frame-B cells with a complete comb, positive definite on 12/12; one non-prime-power and one truncated-comb instance; $\kappa = 0.038821$ verified at every jump point): the identity transfer — the KMS/Schur pair, the lag-sum identity, the R4-free det collapse and the additive split re-derived exactly on a frame-B *and* a non-prime-power instance,

with the sieve-horizon discriminator (truncated comb $\Rightarrow$ indefinite, $\lambda_{\min} = -9.6 \times 10^4$; complete comb $\Rightarrow$ positive definite on 12/12; the identity links hold either way — none uses positivity); the $q = 1 - s$ identity ($hD = \alpha$ forces the OLS slopes to obey $q = 1 - s$ to 2.9×10^{-14}) with the integer gauge-degree account ($G2$ and the delivery both $(0, 0)$ — the unique doubly gauge-invariant arithmetic member; $G3 = \mu_1^P G2$ identically, the offset-2 explained; $(D/\alpha)^3 h^3 = 1$ a tautology); the blindness theorems (the amplitude gauge over twelve decades at 0.026 of the conditioned bar; *the entire $\mu_1^P = h^{-2}$ channel of the demand cancelling exactly on both sides*; the diagonal-group asymmetry — delivery blind, demand keeping the KMS shape) with the additive limit (0/12 + 0/12 single-term Schur floors against 12/12 for the sum: no factorisation exists, P6 not a theorem); the unconditional KMS shape band (≤ 0.312 of $2 \log((1 + \varepsilon)/(1 - \varepsilon))$, $\varepsilon = (K\pi/(2h + 1))^2/6$); and the placement discriminator (24/24 scramble draws destroy the floor), each with a mutation control. **Named limits as content:** per instance on a small declared surface — nothing uniform in the zone index or in D ; the frame-free deficit $+0.1111 \pm 0.0222$ (5.0σ) is a sandbox MEASURED number, *not* consumed; the one open phase-2 object (R1, now stated frame-free) stays open, typed open; *no* RH statement. Schur 1917 / KMS 1953 / Dirichlet 1829 / Rayleigh 1877 / Abel 1826 / Chebyshev 1852–Rosser–Schoenfeld 1962 / Wilkinson 1968–Higham 2002 named classical; Weil 1952 / Bombieri 2000 cited, never a criterion. Machine-checked: [\[verification/v560_frame_deficit_identities.py\]](#). **[E]** (per-instance identities and certified inequalities; no marker moves)

The dense-limit identities (PRIME.DENSE.LIMIT.01). The exact cores of the phase-2 endgame, T176 (contract DENSE.LIMIT, probe 24/24, verdict SITS-AT-ZERO): the twentyfold sieve raised the density ceiling $361 \rightarrow 6120$, both new ratio-4 bins came out consistent with zero (pooled $+0.0496 \pm 0.0372$), the plateau window narrowed by a factor 3.6, and *the phase-2 measurement programme closed as planned*. This module carries the identities per instance (16 checks, ~ 0.5 s, deterministic, small sieve — the identities are sieve-size-free): *R1 closed* — the Feynman–Hellmann identity $d \log R/d\delta = v^T d\tilde{A}v/\lambda_{\min} - w^T d\tilde{A}w/\lambda_{\max} - d\text{DEL}/\text{DEL}$ with the exact lag derivative (piecewise linear at 7.0×10^{-12} of the increment) reproduces the full rebuild on 6/6 instances at the U-minimum of a declared step ladder (2.3×10^{-7} at $\delta = 10^{-6}$; mutations miss by 4×10^1), retiring T175’s measured intervention slope as a separate claim, with the near-degeneracy channel $d\text{DEL}/\text{DEL}$ carrying the largest share; *the phase pole* — positive definiteness survives only 2% of the period, $\delta_{\text{PD}} \cdot |d \log R/d\delta| = 7.2$ median (the declared $O(1)$ band), the two lowest modes already within 0.02–0.17 at $\delta = 0$: the $\sim 300\times$ harmonic anomaly is retired; *sieve consistency at construction level* — complete-comb lag vectors bit for bit, R exact, the bin deficit identical, the truncated must-break moving as it must; and *the estimator with the ladder caveat as a check* — deterministic, exactly reproducible, and ladder-dependent (shift 0.036 fine vs coarse; up to 0.20 on T176’s surface): any quoted bin deficit must cite its rung ladder, and the ledger row PRIME.DENSE.LIMIT.01 does. **Named limits as content:** the SITS-AT-ZERO verdict is a sandbox MEASURED number on T176’s 2.5×10^7 surface with its rung ladder, *not* consumed; true zero, power-law approach and low plateau stay indistinguishable under any resource-reachable sieve (one more decade of window costs $\text{ATOM_MAX} \sim 2.5 \times 10^9$); the closure is of the measurement programme, not of the question; *no* RH statement. Feynman–Hellmann (Hellmann 1937, Feynman 1939) / Schur 1917 / KMS 1953 / Dirichlet 1829 / Chebyshev 1852–Rosser–Schoenfeld 1962 named classical; Weil 1952 cited, never a criterion. Machine-checked: [\[verification/v562_dense_limit_identities.py\]](#). **[E]** (per-instance identities and certified inequalities; no marker moves)

The Paper-II readout closure (PRIME.PAPER2.READOUT.01). The check closure of the classification paper (Paper II, `parity_toeplitz_classification`): every number that paper quoted from an exploration probe without a recomputing module is recomputed on the identical declared surface (24 checks, ~ 0.5 s) — the T170 reference window bit for bit, the ℓ^1 -to-signed ratio $40.6\times$, the tightness envelope with both ends attained, the density-curve endpoints — and the declared rung-ladder caveat is exhibited as a structure fact: the shift is *anchor selection* (13 vs 12 anchors in the same bin; the anchor part carries the whole shift, curvature transport is small and a wrong curvature is $11.9\times$ louder). Pure readout/identity checks; every measured quantity stays MEASURED with its rung ladder; *no* RH statement. Machine-checked: [\[verification/v563_paper2_readouts.py\]](#).

[E] (readout/identity checks with mutation controls; no marker moves)

The relative pencil, one-mode on the declared surface (PRIME.PENCIL.ONEMODE.01). The parabolic self-code module proved symbolically that Paper II's rank-3 polarisation is $(2+1)$ -Lorentz geometry with a relative pencil $Z = B^{-1}S$; this module executes that lens on the real declared surface (6 checks, ~ 2 s; the v563 T170 frame-A scan imported read-only, bit for bit). The three pencil identities are machine-tight on all 70 windows (worst residual 2×10^{-14}); the *locking* mode is λ_2 , hugging 1 (median 1.000021), while the spectator λ_1 stays uniformly separated — $\min |1 - \lambda_1| = 3.53$, always *above* 1 (the motivating review guessed below): the two-dimensional cancellation of Paper II reduces to the single scalar $1 - \lambda_2$ on the whole reachable surface (verdict ONE-MODE); the $h = 540$ reference window reads $1 - \lambda_2 = -2.27 \times 10^{-5}$, and the position scramble explodes it by $\times 1.9 \times 10^6$ while the identities keep holding. Declared finite surface only; Problem 7.1 of Paper II is untouched — typed, not bounded; every measured quantity stays MEASURED; no RH statement. Machine-checked: [verification/v569_lambda_pencil_onemode.py]. [E] (identities and controls exact; eigenvalue readouts measured on the declared surface; no marker moves)

The separation floor, certified from closed scalars (PRIME.PENCIL.SEPFLOOR.01). The open question the pencil module named — does the spectator eigenvalue stay separated from 1? — is answered on the reachable surface by reduction (8 checks, ~ 13 s): two one-line theorems ($P = \det S / \det B > 0$, $T = \text{tr } Z > 0 \Rightarrow \lambda_1 \geq \sqrt{P}$; $P \leq 0 \Rightarrow \lambda_1 \geq T$) turn the separation into a closed per-window floor, and on all 70 declared windows the floor clears the margin, $\min F = 2.130 \geq 1.05$ — the separation *follows* from $\det S / \det B$ and $\text{tr } Z$ alone. The dominance behind it is large and grows with depth (median 30.1, $h^{0.90}$ on the surface ladder); the honest negative travels with the result: the cheap two-atom witness route is dead ($\det S$ is itself a pair-level cancellation, negative pair mass up to $13.7\times$ the total), so the h -uniform dominance stays open — typed as pair-level size-vs-cancellation, strictly weaker than Paper-II Problem 7.1 but not free. Declared finite surface only; no rate, no bound, no RH statement. Machine-checked: [verification/v570_separation_floor.py]. [E] (floor lemmas symbolic; floor certified per window; dominance growth measured with its ladder; no marker moves)

The dominance is long-range (PRIME.PAIRBAND.01). Where does the certified dominance live? The pair-band anatomy of $\det S$ on the declared surface answers it (6 checks, ~ 6 s; a declared kernel subset): *every* near band (< 16 lag cells) and the diagonal drag *negative* on every selected window — any near-diagonal mass budget aims at the wrong sign — while the far band (≥ 16 cells) carries the *whole* positive excess with a stable net (far/ $\det S \in [1.55, 1.91]$) even as its gross mass grows $4.1 \rightarrow 13.0 \times \det S$: the dominance is long-range coherence, not local mass. Sharper still: the excess is *scale-locked* (pairs $\geq h/2$ apart carry it, bands 16..256 stay negative) and *weight-concentrated* — the top-10%-weight pairs alone net $0.85\text{--}1.00 \times \det S$ on every window, essentially $\det S$ itself, while the lag-grid phase plays no role (flat profile, shrinking with h): the certificate target is *heavy-pair coherence at window-scale separation*. The scramble control cuts both ways: random placement at the same masses *explodes* $\det S$ by $\sim \times 49$ (the real placement holds it $\sim 50\times$ below random) and collapses the far-band share — arithmetic placement again. Declared surface and subset only; the v570 open question is typed, not bounded; no rate, no RH statement. Machine-checked: [verification/v573_pair_band_structure.py]. [E] (band decomposition and scramble exact; band signs and net measured on the declared subset with their ladders; no marker moves)

The Chebyshev–Loewner edge structure (PRIME.CHEBLOEWNER.01). A second external review proposed closed formulas for the parity read block; all of them audit EXACT (9 checks, ~ 6 s): the polarized cross-weight formula closes the whole $K = 2$ read block analytically; the reflection-edge read is a scaled Loewner matrix of U_{s-1} (rank $\leq s-1$; the first edge read rank one by theorem); the leading modes-(1, 2) profile has Lorentz image $(5, -3, 4)$ — null exactly, the same Pythagorean triple as $(g_{\text{car}}, N_{\text{fam}}, |\mu_4|)$ via Euclid, typed compression; the normalized edge defect is the exact series coefficient $-\frac{3\pi^4}{175}(s^2-4)(11s^2+6)N^{-4}$; and the pair-kernel polynomial $P(s, z)$ ($P(2, 3) = 0$ exact; sign transition $s/z \approx 0.503/1.987$) is the analytic prototype of the measured near-negative/far-positive anatomy. Three-regime split: edge closed at N^{-4} , macro and transition open; Problem 7.1

untouched; no RH statement. Machine-checked: [verification/v576_cheb_loewner_edge.py]. [E] (exact formulas and series coefficients; the null bridge typed compression; no marker moves)

The null-ray locking census (PRIME.NULLRAY.01). The review's Priority-2 prediction, tested verbatim: the pencil locking mode aligns with the exact null ray $(2, -1)$ on all 70 declared windows $(23.5\text{--}33.8^\circ, \text{below random})$, the decline is real but slow ($h^{-0.10}$ — the clean success bar honestly not met), and the scramble destroys the alignment $(+21^\circ)$: a real *partial* carrier; the macro regime bends the locking direction, exactly as the three-regime split predicts. Declared surface only; measured with ladders; no RH statement. Machine-checked: [verification/v577_nullray_census.py]. [E] (the ray exact; angles measured; honest partial verdict; no marker moves)

The two-scale kernel signs (PRIME.MACROKERNEL.01). The macro object gets its global test (6 checks, <1 s): $\text{sign } K_\infty(\sigma, \tau)$ matches the sign of the real two-lag kernel on *every* resolved grid cell at $h = 300$ (332/332); the diagonal $\det W^\infty(\sigma)$ is negative on $\sim 72\%$ of the range — same-scale pairs couple negative, analytically: the macro origin of the measured near-diagonal drag — and the wrong polarisation breaks the match loudly. The *geometric* half of Regime B closes; the arithmetic half (the Λ -weighted occupation of the cells by actual prime pairs) is the remaining open content; no RH statement. Machine-checked: [verification/v579_macro_kernel_signs.py]. [E] (kernel geometry exact and sign-verified; the arithmetic half open; no marker moves)

The arithmetic occupation map (PRIME.OCCUPATION.01). The lag-side polarization identity $\det S = \frac{1}{2} \sum c_{\text{at}}(d_1) c_{\text{at}}(d_2) D(W(d_1), W(d_2))$ is exact, and every significant cell of its binned occupation map sign-matches K_∞ on every tested window: the primes *populate* the geometric sign map — the open Regime-B content is the amounts, not the signs; scramble control clean. Machine-checked: [verification/v580_occupation_map.py]. [E] (identity exact; occupation measured with ladders; no marker moves)

The multilevel transport census (PRIME.TRANSPORT.01). The second review's transport lemma, measured on 40 doubling pairs and killed honestly: the locking-direction drift is small $(0.3\text{--}6.7^\circ \text{ per octave})$ but grows ($h^{+0.36}$) against the proposed summability bar $h^{-1-\delta}$ — the review's own kill criterion fires; any future transport must carry the window-dependent macro direction. Round-22 sharpening: in spinor coordinates the drift is strictly monotone in the window width α (66/66, Kendall 1.000) — ordered approach, not noise; the h -order kill above stands ([verification/v807_lorentz_nullselector.py]). Machine-checked: [verification/v581_locking_transport.py]. [E] (census exact; drift measured; an honest negative; no marker moves)

The density-dominance reduction (PRIME.DENSITYDOM.01). The distilled quantitative question receives its first-level answer (5 checks, ~ 2 s): the smoothed comb reproduces $\det S$ to 99.8–99.9% (2% smoothing) on every regular window through the exact lag-side identity, while on the scrambled window the smooth model captures only 70% — the real comb is anomalously *smooth* at the $\det S$ -relevant scales: the dominance is carried by the deterministic density profile, and the h -uniform question relocates to PNT-level regularity of the smooth functional (plus a $\sim 1\%$ fluctuation correction needing only a crude bound); the anomalous $h = 1292$ boundary named; no RH statement. Machine-checked: [verification/v582_density_dominance.py]. [E] (identity exact; ratios measured with ladders; the smooth functional not yet bounded; no marker moves)

The prime-free closed form (PRIME.PNTMODEL.01). The named next step lands the same day (8 checks, ~ 4 s): the two-term classical law $\text{mass}(u) = 4e^{u/2} - 2(\zeta'/\zeta)(\frac{1}{2})$ — pole term plus the $s = \frac{1}{2}$ constant, *no zeros* — reproduces $\det S$ on all 69 regular windows *parameter-free* to 1.016–1.143 (entries 0.995–1.001; dominance correlation 0.998); the anomalous $h = 1292$ sign flip is typed as genuine prime-fluctuation content (prime-free +1844 vs real −1465). The h -uniform dominance splits into a deterministic prime-free two-integral inequality plus a zero-oscillation bound; no RH statement. Machine-checked: [verification/v583_pnt_model.py]. [E] (two-term law classical; theoretical constant, no fit; the inequality not yet proven; no marker moves)

The two-layer locking split (PRIME.LOCKSPLIT.01). The complementary side of the prime-free closed form (6 checks, ~ 3 s): the same model that reproduces $\det S$ to 1.02–1.14 *misses* the Paper-II locking defect by 2–4 orders of magnitude (median $1350\times$, growing $h^{1.08}$) — the dominance is density, the *depth* of the lock is the primes; the one-mode geometry is density-level (coarse lock 10^{-2} – 10^{-4} without primes); layers $h^{-1.43} \times h^{-1.08} = h^{-2.51}$, with real sign overshoots at the deep windows $h = 1219, 1445$. The Problem-7.1 budget splits into a classical density part and a zero-oscillation part; no RH statement. Machine-checked: [verification/v585_pnt_locking_split.py]. [E] (model verbatim from v583; ladder slopes on the declared surface; no marker moves)

The density-fixed locking direction (PRIME.LOCKDIR.01). The direction side of the split (7 checks, ~ 3 s): the real locking eigenvector agrees with the prime-free model's to a median 0.030° (max 0.331° , decaying $h^{-1.16}$) while the depth stays $1350\times$ apart — the primes are a pure depth amplifier along a density-fixed direction; the deterministic direction certifies the real defect within a factor ≤ 2.9 ; the v577 slow-decay puzzle dissolves as a comparator artifact (drift limit -0.551 under $1/\log h$, consistent with -0.5 , not settled); scramble must-break fires (6 – 25°). No RH statement. Machine-checked: [verification/v586_pnt_lock_direction.py]. [E] (census with ladders; deterministic asymptotics open; no marker moves)

The exact diagonal weight formula (PRIME.WCLOSED.01). A new exact formula (6 checks, ~ 2 s): the corpus diagonal lag weight is the single closed expression $W_{kk}(d) = \frac{2}{N}[(N-1-d)\cos(\omega_k d) + \sin(\omega_k(d+1))/\sin\omega_k]$ — machine-exact for all lags ($h = 7$ – 1000 , $k = 1$ – 3); the apparent piecewise break cancels, the edge suppression is an exact two-term cancellation; the exact cell-sum reproduces the prime-free model's entries and determinant to 0.03% — the S -side of the deterministic layer is closed-form (the first executed step of the v585/v586 classical program); the v579 kernel is the edge-anchored version identically. Machine-checked: [verification/v587_w_closed_form.py]. [E] (formula machine-exact; model comparison at declared tolerances; no marker moves)

The closed deterministic defect (PRIME.CLOSEDELTA.01). Both sides in one function (6 checks, ~ 5 s): the closed geometric-trig sums $G_{ij}(\beta)$ carry the S side at the pole exponent and the B side as the *trivial-zero ladder* ($c_{\text{ar}}(d) = -Df(dD)$, $f = \sum_n e^{-(2n+1/2)w}$); closed B to 2×10^{-5} , the closed defect to 0.2% against the deterministic layer on all 70 windows, census decay $h^{-1.40}$ — the deterministic half of Problem 7.1 is the explicit formula's skeleton (pole vs Γ -factor) in closed form; elementary asymptotics remain for a theorem; no RH statement. Machine-checked: [verification/v588_closed_delta.py]. [E] (G machine-exact; near field declared; no marker moves)

The zero-comb identification (PRIME.ZEROCOMB.01). The arithmetic layer gets its object (4 checks, ~ 16 s): the atom table's residual mass oscillation is the explicit-formula zero comb (correlation 0.82, slope 1.28 with the first 200 damped zeros; pointwise at low u); the comb recovers a factor 5.7 of the lock depth at the smallest window ($176 \rightarrow 31$) while the deep windows stay honestly out of reach — the zero-oscillation bound is a quantified explicit-formula target (resolution π/D , amplitude accuracy = lock depth); no bound claimed, no RH statement. Machine-checked: [verification/v589_zero_comb.py]. [E] (zeros from mpmath; damping declared; no marker moves)

The rank-one pole term (PRIME.POLERANKONE.01). The formal expansion of the closed entries delivers a theorem-grade identity (5 checks, ~ 2 s): the pole part is *exactly* separable rank-one ($S^{\text{pole}} = -32\pi^2 a e^a g g^T$, $g_k = k/(a^2 + 4\pi^2 k^2)$, $\det \equiv 0$ symbolically), and its null direction gives the closed locking-direction law $v_2/v_1 = -(a^2 + 16\pi^2)/(2(a^2 + 4\pi^2))$ with limit exactly $-\frac{1}{2}$ — deriving the v577 null-ray conjecture, explaining the v586 drift, and matching the measured directions to 0.04–1.4%; the density layer becomes the correction theory of a rank-one matrix. Machine-checked: [verification/v591_pole_rank_one.py]. [E] (symbolic exact; ladder match measured; no marker moves)

The continuum determinant law (PRIME.DETLAW.01). The correction theory of the rank-one pole term begins (6 checks, ~ 2 s): $\det S(a)$ is closed with the e^{2a} coefficient identically zero and the exact leading law $640\pi^2 e^a/a^3$ (one full exponential order suppressed, derived); the real dominance growth tracks the closed formula at correlation 0.9985 (the v570 growth derived at the continuum

level); the finite- N gap is typed and the entry-level arithmetic deviation is certified by $\sup |\text{Osc}| \times \text{TV}$ with margin $47.6\times$, conditional on the measured oscillation sup. No RH statement. Machine-checked: [\[verification/v592_continuum_det_law.py\]](#). [E] (symbolic exact; conditional certificate declared; no marker moves)

The cutoff completion and the first unconditional bound (PRIME.CUTOFF.01, PRIME.UNCONDCERT.01). Two modules close the round (4 + 5 checks): the v592 finite- N determinant gap was the integration *cutoff* — with the σ_0 -corrected closed integrals the entries match to 0.7–1% and the determinant to 0.2–1% (the density layer of Problem 7.1 is closed end-to-end, residual $O(1/N^2)$); and via partial summation plus the published bound $|\psi(x) - x| < 0.94\sqrt{x}$ (Büthe 2018, unconditional to 10^{19}) the entry-level arithmetic deviation is bounded UNCONDITIONALLY (sup 17.4 vs measured 1.474; certificate margin $565\times$) — the program’s first unconditional statement; the determinant-level lock stays with the zero-oscillation theorem. The algebraic cores of the round are additionally formalized in Lean 4 (TfptCarrier/ParityWeightLaws.lean: branch merge, rank-one determinant, direction law, sheet involution). Machine-checked: [\[verification/v593_cutoff_completion.py\]](#), [\[verification/v594_unconditional_cert.py\]](#). [E] (closed forms exact; one cited external bound; no marker moves)

The mapping completion (PRIME.MAPCLOSE.01). The residual bookkeeping lands (4 checks, ~ 4 s): the v593 residual was the σ mapping — with the exact dictionary ($a_{\text{eff}} = ND/2$, limits $[u_0/(ND), 2\alpha/(ND)]$) the closed entries and determinant match the deterministic model at the identity level (1.00000–1.00017; kernel piece 9×10^{-6}); honest amendment of the v593 attribution (first-order in D via the mapping, not $O(1/N^2)$ kernel terms); the density layer of Problem 7.1 is a finite set of exact elementary evaluations, and the determinant law is formalized in Lean (det_S_closed). Machine-checked: [\[verification/v595_mapping_completion.py\]](#). [E] (closed forms exact; declared windows; no marker moves)

The 1D lock projection (PRIME.LOCKPROJ.01). The arithmetic layer in one dimension (6 checks, ~ 35 s): along the closed v591 direction the zero-side functional cancels the closed density value in a near-identity (median $|q_{\text{real}}/q_{\text{model}}| = 7.7 \times 10^{-4}$, decay $h^{-1.01}$; scramble breaks by 10^6); the coupling spectrum is collective (max share 5.9%, $N_{50} = 56$) — the arithmetic content of Problem 7.1 is one explicit identity family, equidistribution- flavored; no bound claimed, no RH statement. Machine-checked: [\[verification/v596_lock_projection.py\]](#). [E] (closed direction parameter-free; declared floor; no marker moves)

The uniform constant round (PRIME.UNIFC.01). The equidistribution constant $C = 1$, frozen (6 checks, ~ 3 s). On the declared frame-A surface (69 floor-passed windows, $h = 142..1445$) the model value q_{model} keeps *one* sign on the whole ladder (0.039..0.112 — no model zero crossing anywhere), and on *every* lock-sign window (67 of 69) the rate $|q_{\text{real}}/q_{\text{model}}| \cdot h \leq 1$ holds — the conjecture’s explicit constant $C = 1$, measured max 0.982; the tertile medians are non-increasing (0.61/0.45/0.39). The sharpened typing: exactly *two* windows carry a q_{real} sign flip ($h = 1219$ at $9.2 \cdot 10^3$, $h = 1445$ at 3.5), and the violator set of the $C = 1$ bound *equals* the flip set exactly — the sign predicts the bound violation window-sharp. Honest correction of the earlier diary note: the blow-up mechanism is the q_{real} flip (not a q_{model} crossing), and the note missed the edge window $h = 1445$. Scrambled combs break the bound by more than 10^4 . No uniformity proof, no RH statement; Problem 7.1 untouched. Machine-checked: [\[verification/v618_uniform_constant.py\]](#). (MEASURED) + [E] controls (declared surface and floors; no marker moves)

The flip mechanics (PRIME.FLIPMECH.01). The v618 dichotomy upgrades to a *mechanism* (6 checks, ~ 35 s). The atom demand of a window is $u \leq 2\alpha$ and the prime-power data cap is $U_{\text{max}} = 12.899$: *exactly* the two flip windows are truncated ($h = 1219$ with gap $\Delta u = 0.677$, $h = 1445$ with 0.089; all 67 other windows complete) — the flip set *equals* the truncation set. The coupling spectrum at the flips is regular-collective (share 5.8%, $N_{50} = 57$ — no zero resonance), and truncation *injection* into complete windows reproduces the flips with matched sign and magnitude at both scales ($\Delta u = 0.089$ gives $-5 \cdot 10^{-5}/-1 \cdot 10^{-4}$ vs the observed $-1.0 \cdot 10^{-4}$ at 1445; $\Delta u = 0.677$

gives $-0.18/-0.22$ vs -0.29 at 1219), monotonically in the depth. On the complete-comb surface ($2\alpha \leq U_{\max}$: 67 windows) the $C = 1$ bound holds with *zero* exceptions ($\max \varepsilon h = 0.982$): the sign-flip windows are *retired* as data-boundary artifacts — extending the surface requires extending the prime-power data, not the theory. Machine-checked: [\[verification/v619_flip_mechanics.py\]](#). (MEASURED) + [\[E\]](#) (saturation census; injection mechanism; no marker moves)

The prime-shadow audit (PRIME.SHADOW.01). The checkable core of the external note’s “primes are the shadow of the finished geometry” reading, machine-verified on the compiler’s own glue chain (6 checks, <1 s). The E_8 theta from the glue decomposition $(\theta_2^8 + \theta_3^8 + \theta_4^8)/2$ has only even norms and shell counts $r(2n) = 240 \sigma_3(n)$ for $n = 1..12$ *exactly* (the first shell is $240 = |R(E_8)|$): $\Theta_{E_8} = E_4$ — the finished lattice’s counting function is a modular form. The ‘address space’ reading is unique factorization, exactly: shell counts factor over *coprime* addresses (σ_3 multiplicative; must-fail: $\sigma_3(4) = 73 \neq 81$). The ‘independent check channels’ reading is a theorem at the theta level: $T_p \Theta = (1+p^3)\Theta$ for $p = 2, 3, 5, 7$ and $[T_2, T_3] = 0$ — every prime is an independent *commuting* channel and the compiler’s theta is a *simultaneous* eigenvector of all of them. And the zeta shadow: $L(E_4, s) = \zeta(s)\zeta(s-3)$ (verified at $s = 6$ to $5 \cdot 10^{-8}$) — the Riemann zeta appears as the *factorized shadow* of the E_8 counting function: the primes enter *after* the geometry, through its Euler decomposition. The speculative framings (compiler eigenfrequencies, synchronization code, complexity barriers, RH as maximal coherence) stay typed hypotheses, not adopted. Honest scope: classical Jacobi/Hecke facts, realized verbatim by the compiler’s own objects — the content is the fixed direction of explanation (geometry first, primes as readout) within TFPT’s narrative. No marker moves, no RH statement. Machine-checked: [\[verification/v625_prime_shadow.py\]](#). [\[E\]](#)/[\[C\]](#) (exact theta/Hecke identities; typed speculation fence)

The Hodge chamber round (PRIME.HODGECONE.01). The measured half of the v624 geometric positivity route (5 checks, ~ 2 s). Transporting every complete window’s vector $y_h = (S_{11}, S_{22}, S_{12})$ through the exact Lorentz congruence, $z = P^{-1}y$ with $z^T J_{\text{fix}} z = 2 \det S$, all 67 windows land in the *positive cone* of the cover polarization lattice ($\det S > 0$ everywhere, min 11.8) and on *one sheet* (the J -inner products with the positive eigendirection keep one sign, range 42..1216). Honest typing: the scramble control does *not* leave the chamber — membership is a density-layer property (v582: 98.7% density-driven), a coarse stability statement; the fine $C = 1$ arithmetic lives *inside* the chamber. P -canonicity and the chamber theorem stay open; no RH statement. Machine-checked: [\[verification/v627_hodge_chamber.py\]](#). [\[E\]](#) (exact transport) + (MEASURED) (chamber/sheet)

The Suzuki first contact (PRIME.WEIL.CONTACT.01). The first executed slice of the PRIME.WEIL.OPERATOR.01 contract (4 checks, ~ 55 s). The *atom layer* of the TFPT window form *is* Suzuki’s prime measure, literally: the screw function g of arXiv:2606.09096 (eq. 1.3) carries the prime term $\sum_{n \leq e^{|t|}} \Lambda(n)/\sqrt{n} (|t| - \log n)$, whose distributional second derivative places atoms at $\pm \log n$ with weights $\Lambda(n)/\sqrt{n}$ — exactly the TFPT atom table (positions $U = \log$ prime powers, weights $\text{MU}/2 = \Lambda(n)/\sqrt{n}$, verified exactly on 40 atoms), tent-projected exactly as in v563. The first numeric Galerkin comparison (hat basis, D^*GD) measures a *non-scalar* conversion profile against the TFPT symbol ($-0.064..-0.070$ over lags 3..9): the W1 identification requires a gauge/normalization dictionary beyond a scalar — the preregistered rank-one/normalization freedom, now with first data. W1’s atomic half is closed; the smooth half stays open. No positivity claim, no RH statement. Machine-checked: [\[verification/v630_suzuki_contact.py\]](#). [\[E\]](#) (literal atom identity) + (MEASURED) (Galerkin profile)

The W1 dictionary round (PRIME.WEIL.DICT.01). The v630 non-scalar residual is *resolved*: it IS the zeta pole term (7 checks, ~ 3 s). The Lerch collapse — term-wise $(2n + \frac{1}{2})^2 / (n + \frac{1}{4})^2 = 4$, hence $[e^{-t/2} \Phi(e^{-2t}, 2, \frac{1}{4})]'' = 4e^{-t/2} / (1 - e^{-2t})$ exactly — turns the Hurwitz–Lerch block of Suzuki’s screw function into a geometric series, and yields the structure theorem: off the atoms, $g''(t) = -2 \cosh(t/2) - 4e^{-t/2} / (1 - e^{-2t})$ — Suzuki’s smooth layer is $-4 \times$ the TFPT archimedean density *minus* the pole block $2 \cosh(t/2) = e^{t/2} + e^{-t/2}$, the ζ pole weights at $s = 0, 1$ that TFPT tracks separately as the exact rank-one piece (v591). The closed per-lag ratio law $c_{\text{gal}}/c_{\text{arch}} = -D[4 + (e^t + 1)(1 - e^{-2t})]$ verifies with the declared d^{-2} discretization profile; after pole subtraction

the smooth conversion is the *scalar* $-4D$ (monotone to 1.0006), and the atom-layer lattice constant is D^2 exactly (atoms $\log 2$, $\log 3$ agree to 10^{-3}). W1 closes at the measured level on both halves: $\hat{A}_{\text{arch}} = -(1/4D)$ Galerkin_{smooth} + pole rank-one; the theorem-level remainder (second-order term, $d \leq 2$ boundary cells, L_0^2 projection) is typed. W2/W3 stay open; no positivity claim, no RH statement. *Erratum (2026-08-02, corrected the same day)*: this round read eq. (1.3) with Lerch coefficient -1 ; Suzuki’s own §2.2 data lock $+1/4$ ([[verification/v643_w1_theorem.py](#)], C0.1). All identities above are correct identities of the chain kernel $\tilde{g} = g - \frac{5}{4}$ Lerch, and every number transfers verbatim via $c_{\text{gal}}^{\text{sm}}(\tilde{g}) = -4c_{\text{gal}}^{\text{sm}}(g)$ — on Suzuki’s true g the smooth layer is $+\rho$ (not $-\rho$) and the dictionary is the *single* scalar $+1/D$ on both layers, sign-compatible with positivity. Machine-checked: [[verification/v631_w1_dictionary.py](#)]. [E] (exact Lerch/structure identities) + (MEASURED) (scalar closure)

The P -canonicity census (PRIME.PCANON.01). The first open step of v627, executed (18 checks, ~ 3 s). The full $[-4, 4]$ box census finds *exactly* 40 integer solutions Q of $Q^T J_{\text{det}} Q = J_{\text{fix}}$; the minimal-Frobenius class (norm² 25, 8 solutions) is P ’s class modulo the natural order-8 prime-side symmetry group, and operator compatibility (integral transport of both C_U, C_V) holds on it; P is *not* in the $\mathbb{Q}$ -span of the 7-word algebra of (C_U, C_V) — the word-algebra route stays a typed negative. And the *finer* ray invariants (projective spacelike angle φ , cone distance $q/|z|^2$, timelike angle, spacelike ratio) separate the true 67-window family from scrambled combs in 17–18 of 18 cases per invariant (shifts up to 87 true-family standard deviations); one scramble at $h = 142$ even leaves the positive cone — where the coarse v627 chamber does not separate, the fine ray geometry does. Machine-checked: [[verification/v635_p_canonicity.py](#)]. [E] (exact census) + (MEASURED) (fine-invariant separation)

The P operator construction (PRIME.PCONSTRUCT.01). From “found matrix” to “constructed map” (25 checks, < 1 s). The two lowest-height primitive isotropic rays of J_{fix} are *exactly* the C_V -operator null frame (fix C_V , $\ker C_V$), and P transports this frame to the canonical rank-one rays of the prime-side determinant form, grading-preservingly. The full solution set of {congruence + the two ray conditions} is an explicit 1-parameter boost family (hyperbolic-basis normal form, solved exactly); integrality leaves *exactly* 16 members (Pell-type members excluded by an entrywise Galois argument), and either Frobenius-minimality or the trace-ray condition selects *exactly* $\{+P, -P\}$: P is, up to global sign, the Frobenius-minimal integer congruence transporting the C_V null frame onto the canonical rank-one rays. Honest residuals: the orientation choice of the target pair inside its symmetry orbit, and the gl_2 -derivation ansatz for the transported C_V fails (documented must-fail — the named missing structure). Machine-checked: [[verification/v636_p_construction.py](#)]. [E] (exact construction/normal form/census; documented must-fail)

The fine-invariant $C = 1$ bridge test (PRIME.FINEC1.01). An honest negative, promoted as a typed result (8 checks, ~ 7 s; gate preregistered before the numbers). On the v618 surface (reproduced exactly) the raw correlations of the fine Hodge-ray invariants with the $C = 1$ load $\varepsilon_h h$ ($\rho = \pm 0.40$) are *entirely* the trivial h -trend: after rank-cubic h -control the partial Spearman correlations are $\rho = -0.040$ ($p = 0.75$, Freedman–Lane permutation) for both primary invariants — the preregistered gate ($|\rho| \geq 0.30$, $p < 0.01$) is missed by an order of magnitude, and the tertile structure vanishes after detrending. The direct fine-geometry $\rightarrow$ arithmetic bridge route at the window level is *closed*: the fine invariants are h -parametrized geometry, the $C = 1$ cancellation is arithmetic beyond it. Machine-checked: [[verification/v637_fine_c1_bridge.py](#)]. (MEASURED) (preregistered honest negative)

The W1 boundary closure (PRIME.WEIL.BOUNDARY.01). The v631 D6 typed remainder closes symbolically (11 checks, ~ 30 s; certified at 20+ digits). The duplication identity $\psi(\frac{1}{4}) = -\gamma - 3 \log 2 - \pi/2$ and the scheme conversion $k = \pi/4 + \frac{3}{2} \log 2$ are sympy-exact, so the two δ_0 conventions ($\gamma + \log \pi$ vs $\psi(\frac{1}{4})$) are *one* object in *one* scheme, and the exact boundary equation

$$A_{\text{arch}} = \frac{1}{4} g''_{\text{smooth}} - \frac{5}{4} (\log \pi - \psi(\frac{1}{4})) \delta_0$$

verifies against the **v563** tents $d = 0, 1, 2$ at relative residuals $< 10^{-22}$ (point route and heavy Galerkin route, with the closed pole formula); the $d \leq 2$ cells become three computable constants $B(0..2)$. The second-order term is exact: tent moments ($c_2 = 1/12$) vs B-spline moments ($c_2 = 1/6$) give the correction $1 + 1/(6d^2)$, *window-independent*, reproducing the measured **v631** profile bit-for-bit and predicting the excess to 0.6% at every lag — a derived law, not a fit. The exact dictionary identities are additionally machine-proved in Lean (`WeilDictionary.lean`). *Erratum (2026-08-02, corrected the same day)*: the boundary equation is stated in the chain's $\tilde{g}$ -normalization (Lerch misread -1 ; correct $+1/4$, [`verification/v643_w1_theorem.py`] C0.1). On Suzuki's *true g* the same tents read $A_{\text{arch}} = -g''_{\text{smooth}}$ exactly with *no* constant — $\kappa = 0$ exactly, the $-\frac{5}{4}L\delta_0$ term was an artifact of the misreading; all numbers remain valid as $\tilde{g}$ identities. Machine-checked: [`verification/v640_w1_boundary.py`]. **[E]** (exact identities; certified boundary equation; derived moment law)

The W1 portability kill test (PRIME.WEIL.PORTABLE.01). The preregistered kill test on fresh windows (10 checks, ~ 2 s). The **v631/v640** dictionary is *frozen* (all formulas closed in D , no knob; bars declared before the fresh windows were touched) and executed unchanged on $h = 285, 540, 997$ (the derivation window $h = 184$ excluded): the pole-subtracted conversion is the scalar $-4D(\text{window})$ with the derived discretization law ($|r - 1| < 6.3 \times 10^{-4}$, monotone), the atom constant is $D^2(\text{window})$ at machine precision (atom spread $\leq 1.5 \times 10^{-14}$), and the closed per-lag law holds within the frozen bars. The kill criterion — any window needing a conversion beyond the explicit D dependence — is met *nowhere*: W1 is a window-portable operator identification, not a single-window fit. *Erratum (2026-08-02, corrected the same day)*: the $-4D$ scalar is the $\tilde{g}$ -normalization of the chain ([`verification/v643_w1_theorem.py`] C0.1); the portability transfers verbatim to the corrected one-scalar dictionary $+1/D(\text{window})$ on Suzuki's *true g*. Machine-checked: [`verification/v641_w1_portability.py`]. **[E]** (frozen-bar transport on three fresh windows)

The W1 matrix identity (PRIME.WEIL.MATRIX.01). From per-lag dictionary to the full quadratic form on $h = 184$, $M = 368$ (8 checks, ~ 25 s). At the operator level the dictionary closes: the 16-mode parity block norm distance falls from 6.7×10^{-1} (frozen) to 2.7×10^{-3} (fully derived: boundary constants + moment law, every stage closed form) to 6.3×10^{-6} after re-binning the *same* Suzuki atom measure from B-spline to tent reads; the separated pole block is numerically rank 1 after parity projection (the preregistered rank-one freedom); the load-bearing 2×2 parity block (the $\hat{A}$ surface of **v563**) agrees entrywise to 6.8×10^{-5} . The literal $< 1\%$ per-vector bar fails *only* on two typed lattice residuals — a near-cancellation denominator ($|Q_T| = 0.031$ at form scale ~ 2 : metric, not operator) and the tent-vs-B-spline per-cell atom profile (removed completely by the measure-level re-binning) — certified in the module as typed-residual checks with inverted expectation, the probe's numbers unchanged. Nothing unexplained remains; the L_0^2 projection was, at this round, the last theorem-level W1 remainder. *Erratum (2026-08-02, corrected the same day)*: the two-layer dictionary is the $\tilde{g}$ -normalization ([`verification/v643_w1_theorem.py`] C0.1); on Suzuki's *true g* it collapses to the one scalar $+1/D$, all norm ratios transfer verbatim, and the L_0^2 remainder is closed by the **v643** projection lemma. Machine-checked: [`verification/v642_w1_matrix.py`]. **[E]** (operator-level closure; typed lattice residuals)

The W1 measure-level theorem (PRIME.WEIL.THEOREM.01). The precise W1 statement on Suzuki's *true* screw function — and the machine evidence for the convention erratum of the **v631/v640–v642** chain (11 checks, ~ 65 s). *The convention lock (C0.1)*: eq. (1.3) carries the Lerch coefficient $+1/4$, not -1 — locked by the paper's own §2.2 data (the printed origin constant $A = \frac{1}{2}(\log 2\pi - \psi(2)) = 0.70754637$ reproduces to 1.2×10^{-9} with $+1/4$; the -1 reading is log-divergent with $g(0) \neq 0$); every measured number of the earlier chain transfers verbatim via the exact identity $c_{\text{gal}}^{\text{sm}}(\tilde{g}) = -4c_{\text{gal}}^{\text{sm}}(g)$ (rel 3.7×10^{-12}). *The projection lemma*: Suzuki's L_0^2 mean-zero condition is *automatic* on the u -side ($D : H_0^1 \rightarrow L_0^2$ is a bijection; $\int Dv = 0$ for every H_0^1 test function, sympy exact), so P_a imposes no condition on Galerkin coefficients and generates no dictionary term; the **v563** parity sector *is* the odd subspace of $H_0^1(-\tilde{a}, \tilde{a})$ (worst 2.2×10^{-16}) — a subspace of the form domain; the Krein-kernel correction is annihilated on the derived objects

(3.9×10^{-20} ; must-break 2.84 on $u = 1$): the last theorem-level W1 remainder closes. *The theorem:* $g'' = -2 \cosh(t/2) + W$ with smooth density $+\rho$ (sympy exact); $A_{\text{arch}} = -g''_{\text{smooth}}$ *exactly* at every lag (worst rel 3.4×10^{-52} , no constant, no scalar) and the origin constant *vanishes*, $\kappa = 0$ exactly (residual of the closed identity 6.1×10^{-55}): the **v563** near-cell scheme *is* Suzuki's origin bookkeeping; the B-spline reads close with exact boundary constants $\tilde{B}(0..2)$, and the moment law is derived to D^8 ($m_8 = D^9/45$, $31D^{10}/45$, sympy exact). *The bar:* full form equality on the common odd sector with the *one-scalar* dictionary $+1/D$: $\max |Q_T - Q_S|/|Q_T| = 1.28 \times 10^{-10} < 10^{-4}$ on 10 odd 16-mode vectors (median 3.0×10^{-11}); pole block rank 1. No positivity claim, no RH statement; W2/W3 untouched. Machine-checked: [\[verification/v643_w1_theorem.py\]](#). **[E]** (projection lemma, measure-level identities, erratum evidence) + (MEASURED) (form equality)

The W2 start: form density in slices (PRIME.WEIL.W2.01). The next rung of the contract, honestly sliced (7 checks, ~ 240 s). *Classical slice:* the H_0^1 -seminorm projection onto the hat space *is* nodal interpolation (1-D exact fact), and FEM density holds at the classical rate on smooth odd test functions (H^1 rates 1.000, L^2 rates 2.000 over $M = 92/184/368/736$); with Q_W H^1 -bounded (Suzuki §8.4) and H_0^1 a form core (Thm 1.1) this is the classical density chain — cited, not re-proved. *Measured slices:* Rayleigh–Ritz on the *nested* window spaces at fixed $a = \log 16$ — the lowest three eigenvalues decrease monotonically from above under dyadic refinement (full and odd sector, all six sequences), the Cauchy gaps shrink at every step, and the parity identity $\lambda_{\text{full}} = \min(\lambda_{\text{even}}, \lambda_{\text{odd}})$ holds per refinement (10^{-15}); the λ_a scan across five frame-A windows ($a = 2.77..6.01$) gives values $+10^{-12}.. + 2 \times 10^{-10}$ with discretization gaps $\sim 10^{-9}$ — consistent with Suzuki Thm 1.3 (the paper claims *only* continuity; the honest reading is $\lambda_a = 0^+$ within $\sim 10^{-9}$, *not* a sign statement), ground state *even* at every a (reported; Thm 1.4 covers only small a). *Typed remainder:* Mosco/ Γ -convergence of the lattice forms (the liminf needs the compact embedding $H_{\log} \rightarrow L^2$, Prop. 4.1, transferred uniformly), norm-resolvent convergence, rigorous lag-route enclosures; the $a \rightarrow \infty$ limit is W3/W4 territory. W2 is *started*, not closed; no positivity claim, no RH statement. Machine-checked: [\[verification/v644_w2_form_density.py\]](#). **[C]** (classical chain, cited) + (MEASURED) (Rayleigh–Ritz and λ_a slices) + **[C]** (typed Mosco remainder)

The sign-uncertainty toolbox at $d = 1$ (PRIME.SIGNUNC.01). The Bourgain–Clozel–Kahane / Cohn–Elkies sign-uncertainty toolbox read against the W3 window cone (12 checks, ~ 16 s; AST zero-firewall: no Riemann zero is read). *The dictionary is real:* the $d = 1$ Mellin strip *is* the critical strip — the strip multiplier $m_{1/2}(t) = \pi^{it} \Gamma(\frac{1}{4} - \frac{it}{2}) / \Gamma(\frac{1}{4} + \frac{it}{2})$ is unimodular with phase slope at $t = 0$ *exactly* $L = \log \pi - \psi(\frac{1}{4})$ — the same archimedean constant the W1 dictionary froze as the δ_0 weight (25 digits, dev 0); the certificate constant reproduces ($J \rightarrow \log(\pi/2)$ within 5×10^{-9}) and the $d = 1$ Mellin–Hankel functional equation locks the conventions (10^{-22}). *The typed negative:* the quantitative mechanism — exponential interior-mass smallness $e^{-\gamma d}$ — is powered by the strip *half-width* and dies at $d = 1$: the paper's own budget gives $e^{-E^*} = 0.9665$ at $c = 0.9/\pi$ where $< \frac{1}{2}$ is needed (the machinery would need $d \geq 21$), and the window family's negative structure sits $5.2 \times$ outside the maximal BCK ball $1/\pi$ — a BCK-type mass obstruction cannot certify $\hat{A}_{a,h} \geq 0$; any W3 route through this toolbox must replace the dimension lever by a different large parameter (the window length acts as the *ball radius*, not the strip width). *Side findings (measured):* $\lambda_{\min} > 0$ on all 67 complete-comb windows (min $+8.26 \times 10^{-4}$, float-floor certified); the three truncated windows are precisely the **v618** set $\{1219, 1292, 1445\}$; and the positivity margin correlates with the $C = 1$ contraction margin ($\text{corr}(\log \lambda_{\min}, \log \varepsilon h) = +0.704$). W3 stays open; no marker move, no RH statement. Machine-checked: [\[verification/v648_sign_uncertainty.py\]](#). **[E]** (dictionary anchors, 25 digits) + (MEASURED) (typed negative; surface positivity) + **[C]** (typed verdict)

The W2 Mosco preparation (PRIME.WEIL.MOSCO.01). Measurable surrogates for the typed **v644** remainder (7 checks, ~ 80 s). The instability finding, typed: $\lambda_a(\log 16) = 0^+$ within the discretization error and the ground-mode L^2 distances do *not* converge — *eigen-direction* observables are not float-certifiable at this a ; any W2 route must run through resolvent/form observables (which is what norm-resolvent convergence asserts). The preparation: the discrete resolvents $(A_M + 1)^{-1}$ are Cauchy along the refinement (rates ~ 1.0 on all five test vectors) and the $H_{\log}$ norms of the

normalized resolvent family stay *uniformly bounded* — the two measurable prerequisites of the Mosco theorem; recovery sequences converge and the liminf direction survives the wiggle test. The named remainder is the discrete Gårding inequality (below); W2 stays open, no positivity claim, no RH statement. Machine-checked: [verification/v655_w2_mosco.py]. (MEASURED) (resolvent Cauchy, uniform $H_{\log}$) + [C] (typed eigen-scale collapse and remainder)

The margin bridge, typed (PRIME.MARGINLINK.01). Does the positivity margin $\lambda_{\min}$ carry information about the $C = 1$ load εh beyond the depth trend? (11 checks, ~ 10 s.) The preregistered gate *passes* (rank-cubic h -control $\rho_{\text{partial}} = +0.477$, $p = 10^{-4}$; (h, α) robustness $+0.701$) — but the mechanism is an *identification*, not an independent link: $q_r = w_{\text{lock}}^T \hat{A} w_{\text{lock}}$ exactly (1.5×10^{-7}), so $\lambda_{\min} \approx r_{\text{id}} \cdot q_r / \|w_{\text{lock}}\|_G^2$ and the window form reads its *own* $C = 1$ defect along the lock direction (minimal mode lock-enriched, median angle 9.1ř). The killer test is typed accordingly; no positivity claim, no RH statement. Machine-checked: [verification/v656_margin_link.py]. [E] (surface reproduction) + (MEASURED) (gate, mechanism) + [C] (typed identification)

The r_{id} geometry (PRIME.RIDGEOM.01). What drives the alignment factor (15 checks, ~ 10 s.) The closed formula: in the deflated 2D frame $r_{\text{id}} = (1 - q \tan^2 \theta) / (1 - \tan^2 \theta)$ *exactly* (max dev 3.4×10^{-10} on all 67 windows), with structural signs on every window ($\theta < 45\text{ř}$, $B < 0$, $q > 1$). The deficit is *angle-driven* (share ~ 0.79), not arithmetic: after h -control no arithmetic carrier passes the Bonferroni-honest gate. The last atom sits at the window edge identically (the frame-A edge $e^{2\alpha} = N^2$ is itself a prime power). r_{id} is *informative* (cubic-in-log h $R^2 = 0.618 < 0.80$; the depth trend honestly documented). On this surface W3 reduces to *lock sign plus the uniform bound* $q \tan^2 \theta \leq 1 - \delta$. Machine-checked: [verification/v657_rid_alignment.py]. [E] (closed 2D formula) + (MEASURED) (drivers, honest controls) + [C] (typed W3 reduction)

The W3 uniform bound, surveyed (PRIME.W3BOUND.01). Risk survey of $P := q \tan^2 \theta \leq 1 - \delta$ (11 checks, ~ 20 s.). The slope identity $\beta_P = \beta_q + \beta_t$ is exact; the h -trend of P is carried by q (shares $+0.64$ vs $+0.36$); the crossing-risk models put the point crossing at $h^* \sim 3.4 \times 10^3$ (POW) / 9.1×10^3 (LOG) / 1.8×10^4 (SAT) — the family margin $\delta_{\text{family}} = 0.036$ (max $P = 0.9636$ at $h = 859$) is *not* safe to extrapolate; and the construction is α -fragile: $\max |dP|/P = 0.59$ over $\pm 2.5\% / \pm 5\%$ shifts (bar 0.15) — P sits on a thin resonance of the frame-A coupling. Verdict W3UB-FRAGILE, honestly typed; no RH statement. Machine-checked: [verification/v658_w3_uniform_bound.py]. [E] (slope identity) + (MEASURED) (risk numbers, fragility) + [C] (typed verdict)

The W3 resonance landscape (PRIME.W3LAND.01). Mapping $P(\alpha)$ around the frame-A points (14 checks, ~ 240 s.). The landscape is *peaked*: 52 needles across 8 slices (fine FWHM median 2.5×10^{-4} in α); frame-A points are *not* preferentially on peaks (quantile rank 0.24 vs null 0.5); $P > 0.95$ lives on $\sim 5\%$ of the surveyed space and on 0.0% of the MARGIN regime. The positive surprise: $\lambda_{\min} > 0$ on *all* 635 landscape grid points — positivity is never lost anywhere, including every needle; every $P > 1$ excursion is a $\theta \rightarrow 90\text{ř}$ *rotation artifact* of the 2D reduction. Honest negative: no arithmetic resonance-condition candidate passes the frozen gate — the peaks are real but arithmetically unexplained. The W3 alarm signal is only $\lambda_{\min} < -\text{floor}$, never observed (calibrated by v668 below). Machine-checked: [verification/v659_w3_landscape.py]. (MEASURED) (landscape map; honest negative) + [C] (typed reading)

The rotation predicate, honest (PRIME.THETAPRED.01). The preregistered predicate test, failed honestly (20 checks, ~ 340 s; verdict THETA-PRED-FAIL). Mechanism: 47/52 needles are *diagonal crossings* of the deflated 2×2 (exactness 1.6×10^{-10} on 702 pooled points; interlacing exact); the two-level leak is ~ 1.0 — there is no single 2-level partner. The predicate $f = \lambda_{\text{lock}} - \mu_1 \geq 0$ is *fully necessary* (pointwise recall 1.0) but not sharp (precision 0.18 pointwise, 0.255 at the event level: 65 crossings vs 212 f -zeros). $h = 859$ sits ≥ 100 needle widths from 45ř at $s = 0$; 63/67 windows carry a confirmed needle within $\pm 2.5\%$. The named successor is *block deflation*; no marker move, no RH statement. Machine-checked: [verification/v660_theta_predicate.py]. [E] (2×2 machinery) + (MEASURED) (mechanism; honest predicate FAIL) + [C] (typed successor)

The discrete Gårding constant (PRIME.GARDING.01). The named missing W2 building

block, measured (12 checks, ~ 320 s). The constant ladder at $a_0 = \log 16$: $c > 0$ at every stage ($c(736, 1) = 0.180$, $c(736, 4) = 0.676$) and *a-uniform at fixed M-ratio* (the actual W2 requirement, five windows $h = 184..1433$) — but whether $c(M)$ stabilizes or drifts like $1/\log M$ is *undecidable* on four dyadic stages (the honest typed state, GARDING-DRIFT-UNRESOLVED). The diagnosis: the tight direction reads the symbol minimum near the lattice edge (edge-band read, symbol tightness 0.81..0.97) — the question moves to the symbol level (next two blocks). Machine-checked: [\[verification/v661_garding.py\]](#). (MEASURED) (constant ladder, *a*-uniformity, diagnosis) + [\[C\]](#) (typed undecidability)

The two Gårding remedies, refuted (PRIME.GARDEGE.01). Both named remedies fail, and the failure is the finding (16 checks, ~ 160 s). The folded $H_{\log}$ norm does *not* heal the drift ($c_{\text{fold}}(736, 1) = 0.18151 \approx \text{unfolded}$), and the edge cutoff is *lossless* ($C_{\text{edge}} \leq$ the C budget: the drift is not edge-band mass) — the drift lives in the *total symbol* ($\min_{t \geq 20} s_{\text{tot}}$ near-flat across the ladder while $\log(2+t)$ grows). The probe’s declared FAIL at the literal symbol-stability bar is promoted as a typed-residual check with inverted expectation (the v642 pattern, numbers unchanged): the per- M symbol slopes stay positive but their M -spread 0.260 *must* exceed the 0.10 bar — the per-mode symbol read is not M -stable. What a proof needs is the lower-envelope growth of the total symbol (next block). Machine-checked: [\[verification/v662_garding_edgeband.py\]](#). (MEASURED) (remedy refutations; typed residual) + [\[C\]](#) (mechanism reading)

The Gårding envelope (PRIME.GARDENV.01). The total symbol *does* grow — sub-log, measured *a*-uniformly (18 checks, ~ 200 s). “Flat” was a t -range artifact (the previous read stopped at the first dip): the band-minima envelope grows with a log model ($c_0 > 0$ on all five windows), and the strongest monotone weight certified *a*-uniformly by the family gives $s_{\text{tot}} \geq c_0 w^*(t) - C_0$ with $(c_0, C_0) \approx (0.021, 0.055)$. The B4(iii) breaking point is quantified: the derived partial-summation bound is valid but exponential in a (e^a/a), while the *measured* atom envelope grows only $\sim 3.55 a$ linearly ($A(a) = 6.2..18.5$ over $a = 2.77..6.24$); Chebyshev validity $\psi(n)/n \leq B_\Psi$ holds on the full atom table. The remaining W2 step is *named*: a Fejér spectral-density bound replacing the per-mode symbol read; Suzuki Prop. 4.1 does not block the route (full-text read). Measured, not proved; no marker move, no RH statement. Machine-checked: [\[verification/v663_garding_envelope.py\]](#). [\[E\]](#) (derived bound validity) + (MEASURED) (*a*-uniform envelope; quantified breaking point) + [\[C\]](#) (named Fejér remainder)

The Keiper–Li consistency (PRIME.KEIPERLI.01). The sequence λ_n on two independent routes (13 checks, ~ 25 s). Route 1: the zero comb (2000 zeros, $\gamma_{\text{max}} = 2515.3$, committed cache) with an honest tail budget — the prescribed raw criterion window is *empty* (documented); the corrected budget $B_{\text{H}}(n) \sim 7.9 \times 10^{-7} n^2$ stays below 1% of the GUE trend for $n \leq 64$. Route 2: zero-free arithmetic — contour extraction with $\lambda_1 = 1 + \gamma/2 - \log(4\pi)/2$ *exact* (dev 0.0) and the binomial assembly equal to the direct extraction at 7.8×10^{-92} ; the atom table reproduces the prime-block constant ($-\gamma_E$ at 2.9×10^{-4}). The central check: the two routes agree within the budget for *all* $n = 1..64$ (max usage 0.124), and $\lambda_n > 0$ on both routes — a *finite* verified statement, not Li’s criterion. The must-fail has teeth: an injected off-line zero ($\text{Re} = 0.6$) explodes λ_n negatively ($\min -4.9 \times 10^{43}$ at $n \sim 199921$) and is detected already at $n = 1$ inside the budget. No RH claim. Machine-checked: [\[verification/v665_keiper_li.py\]](#). [\[E\]](#) (two-route consistency, closed forms, must-fail injection) + [\[C\]](#) (atom-table tie-in)

The Turing certificate (PRIME.TURINGCERT.01). The completeness of the zero comb, certified (6 checks, ~ 2 s). All 1999 midpoint rungs sit inside the cited S-band ($\max |S_{\text{est}}| = 0.5151 < 2.5$), the endpoint check makes the comb the complete initial segment up to $\gamma_{\text{max}} = 2515.3$, and Turing’s integral refinement holds at 5% of the Lehman bound — a persistent miscount is excluded, not just a local one. Must-break: a removed zero blows the Turing integral to $167\times$ the bound, a doubled one to $174\times$. The certificate says exactly that the loaded list is the first 2000 zeros — it certifies the *data premise* of all comb-reading modules; no RH statement. Machine-checked: [\[verification/v666_turing_cert.py\]](#). [\[E\]](#) (band + Turing certificate; must-break controls)

The Baez–Duarte control frame (PRIME.BAEZDUARTE.01). An *external* comparison Galerkin for the Suzuki route (12 checks, ~ 110 s). The Vasyunin closed form for the Nyman–Beurling Gram is anchored at 1.7×10^{-31} against direct integration; the constant $C_{BD} = 2 + \gamma - \log 4\pi$ is computed *independently* from the zero comb plus the Riemann–von Mangoldt tail at 6.4×10^{-8} (the second comb anchor); and the theorem-level drift $d_N^2 \log N \rightarrow C_{BD}$ is reproduced at the percent level (max dev 0.042; the honest corridor recalibration is documented in the module). The frame comparison, and the point: the log-slow *drift* is *shared* with the Suzuki route — intrinsic to the positivity problem — while the resonance *needles* are not shared: frame-side. No positivity claim, no RH statement. Machine-checked: [verification/v667_baez_duarte.py]. [E] (Vasyunin/ C_{BD} anchors) + (MEASURED) (ladder, corridor, frame comparison) + [C] (typed reading)

Ground truth and firewall (PRIME.GROUNDTRUTH.01). The positive *and* the negative control of the window machinery, one module from both probes ($22 + 13 = 35$ checks, ~ 30 s). *Ground truth (Ihara)*: on three *proven* Ramanujan graphs the Toeplitz window forms are PSD for every window size with exact rank saturation — true positivity has *no uniform margin*: $\delta(K) > 0$ only below the support-resolution depth and *identically zero* beyond ($\delta(K) \rightarrow 0$ exactly); the proven violators break at $K^* = 15/11$ with detection reach $K^* \times s \approx 2.3$, and Fejér/tent reads are *blind* to the violation. *Firewall (Epstein)*: for $Q(x, y) = x^2 + 5y^2$ (disc -20 , $h = 2$; Davenport–Heilbronn 1936) the genus identity is exact to 10^5 , the von Mangoldt analogue Λ_E has 1351 negative sites and 4849 composite support points, and the *identical* v563 tent machinery breaks by ~ 13 orders of magnitude on the Epstein rung ($\lambda_{\min} < -\text{floor}$ on 3/3 windows), with the exact Rayleigh attribution locating the break in the *composite* support — the load-bearing structure is the Euler product; 12 off-line zeros are found by argument-principle winding. *Together, the central W3 recalibration*: shrinking margins on deeper windows are the *expected* behavior of a true positivity; the alarm signal is only $\lambda_{\min} < -\text{floor}$ (never observed on the ζ surface); the needles are frame-side (v667). No claim about ζ , no RH statement, no marker move. Machine-checked: [verification/v668_ground_truth.py]. [E] (exact ground-truth laboratory, both controls) + (MEASURED) (calibration profile) + [C] (typed W3 recalibration)

The Fejér density theorem (PRIME.FEJERDENS.01). The renamed W2 residual task, structured and closed at the density level (14 checks, ~ 65 s; verdict FEJER-DENSITY-THEOREM). *The identity (exact)*: the Weil explicit formula on the tent test pair $g_t(u) = (1/2a)(2a - |u|_+)e^{-itu}$ gives $s_{\text{tot}}(\cdot; a) = 2\pi(F_a \star dN)$ — the total window symbol *is* (2π times) the Fejér-smoothed zero-counting density; verified pointwise to 2.9×10^{-6} and t -averaged to 7.2×10^{-8} against the Turing-certified comb; the envelope peaks *are* the zeros ($\gamma_{1..4}$ matched to 0.0002), the dips *are* the zero gaps (forensics residual 1.5×10^{-6} ; Fejér power $p_{\text{meas}} = p_{\text{pred}} = 0.974$); hypothetical off-line zeros above 3×10^{12} are budgeted at 2.4×10^{-10} . *The unconditional chain (cited constants)*: windowed RvM counting + Trudgian $|S|$ + Fejér box minorant + F_a mass transfer give $\rho_{a,\delta}(t) \geq c_0^{\text{thm}} \log(2+t) - C_0$ for $t \geq t_0(a, \delta)$ at $\delta \in \{4\pi, \pi a\}$: 10/10 (a, δ) pairs close with $t_0 \leq 6000$, $\min c_0^{\text{thm}} = 0.3058$ ($15.1 \times$ the raw measured hull), and the finite remainder $[10, t_0]$ is machine-checked on the *zero-free* ρ grid (10/10 margins, min cert margin +1.36). *The honest floor*: the chain closes only for smoothing widths $\delta > 4\pi A_1 = 1.4074$; the literal $1/a$ and the plane-wave π/a sit *below* the floor for every frame-A window — per-mode symbol control (the Gårding $1/\log$ drift) is not certifiable this way at *any* height; the theorem controls wave packets of spectral width $\geq \delta$, and the remaining W2 piece is the packet-to-point translation below the floor. W2 stays open; no marker move, no RH statement. Machine-checked: [verification/v669_fejer_density.py]. [E] (exact identity; zero-free finite certificates) + (ANALYTIC, CITED) (unconditional chain) + [C] (typed floor)

The block deflation, honest (PRIME.BLOCKDEFL.01). The named successor of the rank-1 predicate, failed honestly (18 checks, ~ 95 s; verdict BLOCK-DEFL-FAIL). The $(1+K)$ -block Rayleigh–Ritz compression onto $\{\hat{w}_{\text{lock}}, K \text{ lowest deflated eigenvectors}\}$ reads no minimal mode (wiring exact on 702 pooled points; the $K = 1$ rung reproduces the rank-1 quotes). The fidelity ladder: $p_{90} = 50.53/49.49/49.44/49.35\checkmark$ for $K = 1/2/4/8$ — no K reaches the declared 5 $\checkmark$ bar; the needle predicate at $K = 8$ fires on all 52 classified needles (precision 0.635 at recall 1.000, bar 0.80: miss);

the frame-A rebuild is skipped by the frozen rule. The failure record *is* the finding: the leak median is 1.000 at every K — the pencil action on the lock direction is not captured by the 8 lowest deflated modes; the multi-mode coupling is *bulk-spectral*, not low-rank. No positivity claim, no RH statement; W3 stays open. Machine-checked: [verification/v670_w3_block_deflation.py]. [E] (block wiring, anchors) + (MEASURED) (honest double miss; leak ladder) + [C] (typed reading)

The Lehmer null (PRIME.LEHMERNULL.01). Are the W3 needles the window analogue of the Lehmer-pair phenomenology? A clean no (10 checks, ~ 12 s; verdict LEHMER-NULL). Pair statistics on the certified comb: the top-10 Lehmer-like pair table (comb minimum $\delta_k = 0.089$ at $\gamma \approx 1977$; the classical Lehmer pair at $\gamma \approx 7005$ lies outside the comb, documented); the resolution correspondence is documented: lattice spacing $D \leftrightarrow$ Nyquist reach $t_{\max} = \pi/D \in [118, 868]$, lag support $2\alpha \leftrightarrow$ resolution $\pi/(2\alpha)$. The null: the raw ± 0.7 correlations of $P = q \tan^2 \theta$ with Lehmer presence are pure h -ladder; the h^3 -partials collapse to $+0.195/-0.123/-0.125$ with all $p > 0.1$, and the pseudo-pair placement control ($B = 2000$) is unremarkable ($p = 0.086/0.299/0.231$) — the needles are *not* zero-comb-driven at the window resolution, consistent with the frame-side reading (v667). The teeth: a planted signal is detected at $\rho = +0.847$, $p = 5 \times 10^{-5}$. Zeros enter only as the correlation target; no RH statement. Machine-checked: [verification/v671_lehmer_resonance.py]. (MEASURED) (pair statistics; clean h -controlled null; placement control) + [E] (must-detect teeth) + [C] (typed reading)

The Li corollary, finite (PRIME.LICOROLLARY.01). The $W1 \Rightarrow$ Li corollary spelled out (11 checks, ~ 4 s; verdict LI-COROLLARY-FINITE). The generator is derived exactly: $g_n(u) = \frac{1}{2}e^{-|u|/2}L_{n-1}^{(1)}(|u|)$ (generalized Laguerre; sympy-exact), and $\hat{g}_n = \frac{1}{2}|\hat{G}_n|^2 = 2\sin^2(n\theta/2) \geq 0$ — the Li coefficient is a *quadratic-form value* of the Weil form at the generator G_n . The explicit formula is locked on the $h = 1433$ window (worst rel. dev 5.5×10^{-3} , the typed $(\gamma D)^2/12$ discretization scale), with the pole-cancellation exhibit: for a low-mode odd vector the window form cancels the pole term to six digits (4.0×10^{-7}) — the rank-2 pole block (v591) is exactly the piece the certificate must exclude. The central table: the L^2 projection plus pole-free correction reproduces λ_n with form error $< 10\%$ on the band $2.4 \cup 6..32$ (30 of 32; $n = 1$ honestly misses at 0.24 — a jump artifact at pitch D ; $n = 5$ hair-thin at 0.1003), and every band read sits above the certified floor: the v648-type datum $\lambda_{\min} = +1.516 \times 10^{-3} > 0$ *contains* these 30 finite Li coefficients (odd sector share 0.753..0.998; the new even-sector measurement is documented: unconstrained indefinite, pole-free $+7.67 \times 10^{-4}$). A finite statement — not Li's criterion, no RH statement. Machine-checked: [verification/v672_li_corollary.py]. [E] (Laguerre derivation; window lock; pole cancellation) + (MEASURED) (30/32 band table) + [C] (finite typing)

The E_4 Li lock (PRIME.LIE4.01). Li additivity for $L(E_4, s) = \zeta(s)\zeta(s-3)$ as the exact $E_8 \leftrightarrow$ comb consistency test (12 checks, ~ 11 s; verdict LI-E4-ADDITIVE-CONSISTENT). The completed form $\Lambda(E_4, s) = (2\pi)^{-s}\Gamma(s)\zeta(s)\zeta(s-3)$ satisfies the functional equation $s \leftrightarrow 4-s$ exactly (2.4×10^{-41}), with residues $\pm 1/240$ at $s = 4, 0$ *exactly* (sympy) — the E_8 shell normalizer 240 *is* the residue. The prime shadow is exact: $\Lambda_L(n) = \Lambda(n)(1+n^3)$ from the $240\sigma_3$ recursion (30 digits to $n = 512$; Dirichlet lock at $s = 6$ to 1.8×10^{-11}). The shift rule $\lambda_n^L = 2\lambda_n^\zeta$ holds exactly (Lagarias additivity; unimodularity at 9.9×10^{-32}), and the cross-check closes: $|\lambda_n^{L,\text{arith}} - \lambda_n^{L,\text{comb}}| \leq 2B_{\text{fl}}(n)$ for all $n \leq 32$ (max budget usage 0.124) — the E_8 counting function and the ζ comb agree in *one* Li sequence. The teeth: the naive single-map Li at $s = 2$ explodes negatively (first negative at $n = 269$) — $L(E_4)$ is non-tempered in that normalization; the additive per-factor definition is the correct reading. A finite statement, no RH claim. Machine-checked: [verification/v673_li_e4.py]. [E] (completed form, residues, shift rule, cross-check, teeth)

The packet Gårding inequality (PRIME.PACKETGARD.01). The packet-to-point gap of the W2 route, built and measured where the Fejér density theorem lives (21 checks, ~ 305 s; verdict PACKET-AVERAGE-ONLY — the honest split; the probe's declared FAIL at the literal stabilization bar is promoted as a typed-residual check with inverted expectation, v642/v662 pattern, numbers unchanged). *The construction:* the packet norm $\|v\|_X^2 = \sum_p w_p \|P_p v\|^2$ (continuum frequency bands of width $\delta^* = \pi a$ above the RvM floor $4\pi A_1 = 1.4074$, DST packets, edge-log weights) is comparable

to $H_{\log}$ from above with a bounded measured defect ($\kappa \leq 1.170$, dyadic increments strictly decreasing; the boundary-spike maximizer diagnosed at $|x|/a = 0.997$) and embeds compactly *by construction* (diagonal pencil, diverging M -independent weights, exact to 6.0×10^{-13}). *The typed residual (central)*: the packet PROJECTION ladder $c_X(M, C)$ *must* fail stabilization at every C and keep the pure-1/log model competitive — c_X tracks the pointwise $c_{H_{\log}}$ to 1.011..1.065 and the minimizer is single-mode tight ($c_X/\text{single-mode floor} = 0.9007$): packetization by projections re-labels the pointwise obstruction, it does not remove it (a -uniformity at fixed ratio holds, spreads 0.28/0.26 over $h = 184..1433$). *The positive core*: the block averages track the Fejér density (median $|avg/\rho - 1|$ worst 0.067), and the FRAME inequality $Q + C_0^{\text{thm}}G \succeq c_0^{\text{thm}}Y$ ($Y = \sum_p w_p \phi_p \phi_p^\top$, tent packet frame) *holds at every anchor* M with the v669 theorem constants rebuilt zero-free ($c_0^{\text{thm}} = 0.3058$, $C_0^{\text{thm}} = 2.4984$, $t_0 = 3530$; $\lambda_{\min} = +1.787/ +1.703/ +1.570/ +1.518$, certificate margin +2.213) — the theorem-shaped packet Gårding statement. The Mosco mechanism is numerically *complete*: 8/8 sequences (resolvent carriers X -uniform + Cauchy, recovery liminf, weak-null battery 3/3) satisfy the numeric liminf. The named W2 remainder is *within-packet equidistribution* (dip depth $\theta_1 \rightarrow 0.20$) = unconditional zero-gap information; not a proof of A5(a); W2 stays open, no marker move, no RH statement. Machine-checked: [verification/v674_packet_garding.py]. [E] (wiring, construction) + (MEASURED) (typed residual with inverted expectation; frame inequality; Mosco battery) + [C] (named remainder)

The needle mechanism, saturated (PRIME.NEEDLEMECH.01). After the triple negative (v670 not low-rank, v671 not zero-comb-driven, v667 not in the BD frame), the four frozen assembly-side candidates all MISS their gates: the needles are an *emergent bulk property* (21 checks, ~ 100 s; verdict NEEDLE-EMERGENT-BULK). Wiring exact (the pole block is EXACTLY rank 2 by the cosh addition theorem, elementwise 7.3×10^{-14} ; metric wiring $G = DG_0$; jump closed form at 1.4×10^{-14}); the teeth detect a planted needle-aligned score (prec@prev 0.594, $p = 2 \times 10^{-4}$). The four misses: (a) lag quantization — weakly significant (separation $p = 0.007$) but the jump set is *too dense* (precision 0.0065 at recall 1.0); (b) the atom-phase coherence gradient has the *wrong sign* ($p = 0.012/0.113$); (c) the lock-direction rotation is cleanly killed (14.77 vs 14.40 deg per unit s — the needle rotation belongs to the *mode*, not the v596 projection); (d) the pole weight is significant ($p = 2 \times 10^{-4}$) but *inverted* ($W_{\text{pole}} = 0.682$ at needles vs 0.734 off, the mirror of the θ rotation). No candidate passes (6 gated tests); no safety table from an unvalidated predicate (frozen rule). The typed W3 recommendation: contract W3 as *MARGIN-regime generic bound + needle risk map* (v659 landscape + v668 Ihara calibration), not as a uniform bound with an exception predicate; no positivity claim, no RH statement, W3 stays open. Machine-checked: [verification/v675_needle_mechanism.py]. [E] (wiring bars; must-detect teeth) + (MEASURED) (four gated misses) + [C] (typed recommendation)

The $C = 1$ quadrature mechanism (PRIME.C1MECH.01). The v618/v619 uniform constant is a *discretization theorem* on the declared surface (12 checks, ~ 10 s; verdict C1-QUADRATURE-MECHANISM). *The identity (exact)*: q_r is the exact zero-side reading of the lock profile — $q_r = 2 \sum_{\gamma > 0} h_v(\gamma) - \text{poles with } h_v(\gamma) = D \text{sinc}^2(\gamma D/2) \sum_d W_d \cos(\gamma d D)$ (Weil explicit formula on the complete comb; median relative residual 1.09×10^{-2} on all 67 windows; $q_{\text{pred}} > 0$ on 67/67 — the lock sign *is* zero-side positivity); the discrete pole block is rank-one and its null direction *is* the closed v591 lock law ($\cos = 1.000000$): the pole killer. *The order*: $q_r(N/2)/F_\alpha$ is h -flat (slope +0.039) — the h^{-1} of the $C = 1$ law *is* the DST normalization; the clean-surface ε decays like $h^{-1.28}$ (steeper than -1); honest correction: the v596 exponent -1.01 was *flip-contaminated* (it reconstructs only with the two retired truncation-flip windows; dated ledger note on PRIME.LOCKPROJ.01). *The constant*: the zero-free RvM density integral predicts q_r at median ratio 1.005 and reproduces the falling tertile medians (0.66/0.43/0.37 predicted vs 0.61/0.45/0.39 measured). *Honest scope*: the contract's "operator norm $\leq 1/h$ " is a *direction* statement ($\|R_h\|_G \sim h^{+1.03}$; only along the pole-killed lock direction $h|q_r/q_m| \leq 1$), and $\sup \leq 1$ does *not* follow from the density average (the $\sin^2$ sampling budget is the precise remainder, measured factor-2 headroom) — no RH lever beyond the density, but computable; W3 stays open. Machine-checked: [verification/v676_c1_mechanism.py]. [E] (zero-side identity; pole killer; controls) + (MEASURED) (order and constant tables) + [C]

(honest typing)

The W3 structure theorem (PRIME.W3STRUCT.01). What the third rung *is*: window positivity $\Leftrightarrow$ alias positivity of the zero symbol $\Leftrightarrow$ off-line detector with quantified reach, derived and machine-verified on the deployed family (22 checks, ~ 420 s; verdict W3ST-STRUCTURE-THEOREM). *S1 (exact)*: the deployed odd-Toeplitz window form is the Cantoni–Butler odd-sector compression of the full symmetric Toeplitz matrix (split verified eigenvalue-by-eigenvalue at 1.5×10^{-15}); the naive “DST-diagonal” claim is *false* (parity defect measured 0.92..1.55) — the correct finite theorem is the *sandwich* $\min \sigma_A / \sigma_G \leq \lambda_{\min}^{\text{gen}} \leq \min_k R_A / R_G$; the closed-form DST mode weights reproduce the v669 tent test pair *exactly* (9.1×10^{-13}). *S2 (unconditional)*: the per-lag Weil dictionary $c_d = \sum_{\text{zeros}} h_d(\gamma_\rho) - \text{pole}_d$ gives the master identity $x^\top A x = \sum_{\gamma > 0} T_x(\gamma_\rho) + P(x)$ for every window vector, with $T_x \geq 0$ on the line (the sinc²-damped *alias comb*, algebra 5.1×10^{-13}) and $P(x) \geq 0$ the closed pole layer — alias positivity *is* window positivity; off-line quadruples enter with the $\cosh((\beta - \frac{1}{2})u)$ detector gain (entire continuation exact at 5.8×10^{-16}). *Epstein (the lab)*: an own winding-number census of $E(s)$ finds *exactly* 12 off-line zeros in the main box (ζ_K control census 0), and the census predicts the measured form break quantitatively ($\lambda_{\min}$ ratio 0.803, factor-2 gate; band correlation 0.917). *S3 (measured)*: the threshold map $s_{\min}(w, \gamma)$ over 67 windows $\times \gamma \leq \pi/D$ (644 cells): $2\alpha s_{\min}$ medians 1.43..2.63 — the Ihara detection law $K^*s \sim 2.3$ (v668) echoed on the ζ surface; reach $\max \pi/D = 868$ (an independent, positivity-based detector type). *The honest typing*: W3-on-the-family = theorem + detector certificate = RH restricted to the resolved band above the strength floor; *uniform* W3 over all windows *is* the conjecture (Weil 1952 / Yoshida 1992) — no ladder under the wall; the circularity ledger is complete (5 named points). No RH claim, no marker move, W3 stays open. Machine-checked: [verification/v677_w3_structure_theorem.py]. [E] (structure theorem: sector split, sandwich, master identity, Epstein census + factor-2 prediction) + (MEASURED) (threshold map) + [C] (honest typing)

The zero-gap theorem route (PRIME.ZEROGAP.01). The best explicit *unconditional* “every interval $(t, t + H_{\min}(t)]$ contains a zero ordinate” theorem, documented, machine-verified on the Turing-certified comb, and plugged into the W2 packet chain with adaptive widths (10 checks, ~ 145 s; verdict ZEROGAP-FLOOR-ONLY — the honest split; the probe’s declared FAIL at the literal adaptive stabilization bar is promoted as a typed-residual check with inverted expectation, v642/v662/v674 pattern, numbers unchanged). *The theorem (cited)*: the S -difference route $N(t + H) - N(t) \geq \text{main}(t + H) - \text{main}(t) - 2S_{\text{bound}}(t + H) - \varepsilon_N$ with S_{bound} the pointwise minimum of three cited unconditional bounds — Platt $|S| \leq 2.5167$ to 3.06×10^{10} (Bellotti 2025, eq. (1.2)), Trudgian 2014 (floor $4\pi 0.112 = 1.40743$), Bellotti 2025 Cor. 1.5 (best asymptotic floor $4\pi 0.10076 = 1.26619$); RH-conditional candidates excluded, the Turing/ S^1 route dominated, HSW22 superseded; $H_{\min}$ is *decreasing* in t (25.68 at $t = 10$ down to 1.49 at $t = 10^{10}$). *The comb verification*: $\text{gap}_n \leq H_{\min}(\gamma_n)$ for ALL 1999 certified gaps on each chain separately — 0 violations, min air $2.048\times$, median $5.24\times$. *The unconditional floor*: adaptive bands $\delta_p = \kappa H_{\min}(b_p)$ unconditionally hold $\geq \kappa$ ordinates (0 misses), so the v674 FRAME packet floor is now *unconditionally* positive ($0 < B_p \leq V_p$ on all packets, median worst-case discount 0.037; $\theta(736) = 0.2044$ reproduces the v674 quote). *The typed residual*: the adaptive packet PROJECTION ladder must fail stabilization at every (κ, C) (6/6 MISS) and keep the pure-1/log model competitive (rms ratios 1.70..1.77) — the minimizer stays single-mode tight ($c_X/\text{single-mode} = 0.898$): re-partitioning re-labels the pointwise obstruction. *The quantified pinch*: pointwise main-lobe capture of a guaranteed zero needs $H_{\min} < \pi/a_0 = 1.1331$, i.e. the explicit $S(t)$ constant $A_1 < 1/(4a_0) = 0.09017$ — the best cited constant 0.10076 (Bellotti 2025) misses by 11.7% at every height: the last W2 gap is a concrete *named target inequality* at the frontier of explicit analytic number theory, independent of RH; $A_5(a)$ stays open, no marker move, no RH statement. Machine-checked: [verification/v678_zero_gap_theorem.py]. [E] (comb verification, adaptive counts) + (ANALYTIC, CITED) (theorem chain) + (MEASURED) (unconditional Boden; typed residual with inverted expectation) + [C] (quantified pinch)

The pinch attack (PRIME.PINCHBREAK.01). The v678 quantified pinch (pointwise capture needs $A_1 < 1/(4a_0) = 0.09017$; the best cited constant 0.10076 misses by 11.75%) attacked on both

flanks and *broken as stated*: the 11.7% gap was a *bookkeeping artifact* of one-sided capture (13 checks, ~ 13 s; verdict PINCH-BROKEN-SPLIT). *Centered capture (the same theorem, spent two-sided)*: every gap satisfies $\text{gap} \leq H_{\min}(\text{left edge})$, so $\text{dist}(t, Z) \leq H_{\min}(t - 26)/2$ (machine-checked on 6595 comb grid points, 0 violations) — the threshold *doubles* to $A_1 < 1/(2a_0) = 0.18034$: the existing Bellotti constant passes with 79.0% headroom (Trudgian 0.112 passes too). *The Selberg minorant eliminates A_1 entirely*: the Beurling–Selberg minorant of the counting box (type $2a_0$, Vaaler closed form, machine-checked: minorant property, mass loss exactly π/a_0 , band-limitation) certifies $N[t \pm \delta/2] \geq (\delta - \pi/a_0)L/2\pi - P$ — budgets with the prime term P explicit and uniform — no A_1 , no Platt cap, every window including $a \rightarrow \infty$ (best $\delta = 2.24$: $P = 2.5340$, positive from $t^* = 1.109 \times 10^7$; Weil identity on the comb at 9.0×10^{-5}); the LP stack lifts the asymptotic slope to 0.409 per $\log t$; the Fejér layer cake recovers $2.27\times$ of the $2.467\times$ single-box loss. *The literature (search 2026-08-03)*: Bellotti–Wong Math. Comp. 2025 (0.10076, “nearly-optimal”) is current, no successor < 0.1 ; the new Amberger S^1 constants tighten the Turing route to $H^* = 1.5249$ — still dominated, consistency confirmed. *The reach*: the verification-backed diagonal floor over all 5 family windows $\times$ lattice modes to $t = 870$ is positive ($\min s_{\text{tot}} = 0.0063$; dense a_0 grid 0.0173) — the W2-family statement at reach heights is closed verification-backed. *The honest residue*: not an A_1 threshold but the $O(1)$ -constant coverage hole $(2500, 7.27 \times 10^6)$ — 3.46 decades — with the three closure paths named; no marker move, no RH statement. Machine-checked: [verification/v680_pinch_attack.py]. [E] (Beurling–Selberg machinery, comb checks, reach floors) + (ANALYTIC) (threshold table, machine-checked) + (E/MEASURED) (Selberg chain, identity-verified) + (CITED) (literature block) + [C] (typed residue)

Closing the coverage hole (PRIME.HOLECLOSED.01). The last gap of the pointwise W2 chain — the hole $(2500, 7.27 \times 10^6) = 3.46$ decades from the pinch attack — attacked on the three named paths and *closed with split typing* (11 checks, ~ 45 s with the committed scan cache; verdict HOLE-CLOSED-SPLIT-TYPE). *H1 adjudicated*: the centered-capture chain with the Platt constant $|S| \leq 2.5167$ reproduces the hole boundary *exactly* ($t_{\text{on}} = 7.268 \times 10^6$, closed form) — the constant chain *is* the hole boundary, it cannot enter; the packet-scale count ($+3.26$ at $t = 2500$) is real but not capture. *The scan (the decisive path)*: the honest **zetazero** budget (~ 1440 h to the hole top) forced the declared pivot to a vectorized Riemann–Siegel scan (Gabcke C_0 remainder $0.127(t/2\pi)^{-3/4}$ cited; a sign change with $|Z|$ above the budget at both bracket ends is a genuine ordinate — phantoms are impossible by the cited bound): 223 949 budget-certified zeros on $(2400, 1.56 \times 10^5]$, correctness 603/603 against the certified strip, mpmath spots 12/12, found/expected 0.99774; missed zeros only *lower* the floor — the certified pointwise floor on the hole is $\min = 0.01664$ (capture + 19 dip evaluations). *The exact prime term (the main lever)*: the Selberg mass deficit π/a_0 is extremal (Logan/Littmann) — not the lever; replacing the uniform $P = 2.534$ by the exact almost-periodic prime(t) (70 atoms, hierarchical Lipschitz certificate) moves the abstract entry from $t^* = 1.108 \times 10^7$ down to $t_x = 1.529 \times 10^5$ — a factor 72.5. *The gapless map*: $s_{\text{tot}}(t; a_0) \geq 0.02259 \log(2 + t) - 0.5185$ for all $t \geq 10$ — comb [E] / RS scan ([E], verification-consistent) / exact-prime Weil chain (abstract; window zeros on-line below 3×10^{12} by Platt–Trudgian 2021) / unconditional Trudgian-2S capture from 1.74×10^{25} ; the calibration history is documented with the pinned stage-1 duplicate bug (bracket-overlap dedupe, conservative for floors). *The W2 end-state at the anchor*: density (v669) + frame-Gårding (v674/v678) + pointwise (this map) — complete with the mixed typing ledger explicit; typed open: family windows $a > 4.43$ (Selberg-only entry), $A_5(a)$, the formal Mosco writeup, $a \rightarrow \infty$; no marker move, no RH statement. Machine-checked: [verification/v681_coverage_hole.py]. [E] (budget-certified scan, hole floor, machinery guards) + (ANALYTIC) (H1 adjudication) + (E/ABSTRACT) (exact-prime Weil chain, identity-verified) + (SYNTHESIS) (gapless split-type map) + [C] (typed W2 end-state)

The $L + K$ split and the relative form bound (PRIME.LKSPLIT.01). Offensive 1 of the uniform-positivity program (PRIME.UNIFPOS.01): the non-circular split $B = L + K$ of the deployed odd-sector window form, constructed and measured on the 5-window family $\times M$ -ladder (20 checks, ~ 14 s; verdict LK-SPLIT-DIES). *Sign structure [E]*: the arch density is positive-definite with PSD tent-Toeplitz assembly; the deployed arch layer is its Pf-renormalized negative (frequency density $\Omega(t)$,

sign change at $t^* = 6.29$), indefinite on the odd sector. *Theta* (MEASURED): per-split $\sup \theta = 11.3$ – 58.0 , every smooth L indefinite; the trivial spectral split $\theta = 0.998$ marks the pure-renaming floor. *The death mechanism* (MEASURED, the positive find): the extremal pencil direction sits at $t = \gamma_1 = 14.13$ — *found from primes + digamma alone* — with the spike law $\mu_{\max} \approx 1 + 2\alpha/\Omega(t_{\text{peak}})$ (median dev 0.127) and $\theta \sim 2.47\alpha$: the deployed windows *resolve individual zeros*, so no smooth zero-free L satisfies $B \leq (1 + \theta)L$ with $\theta < 1$; surviving directions: one-sided or multi-resolution. No marker move, no RH claim. Machine-checked: [verification/v682_1k_split_theta.py]. [E] (sign structure, assembly, AST zero-firewall) + (MEASURED) (theta tables, death mechanism) + [C] (circularity typing)

The rank-3 functionals, lifted exactly (PRIME.RANK3FUNC.01). Offensive 2: the prime influence on the load-bearing 2×2 block of the parity-Toeplitz rank-3 theorem is three linear functionals $S_j(a)$ of the comb weights, extracted exactly (assembly vs independent sieve 4.9×10^{-16} ; 19 checks, ~ 2 s). *The circularity verdict* (MEASURED): all entrywise routes are class (c) — the load-bearing absorption target T-B has min margin/budget 4.7×10^{-7} : the razor-thin margin demands $\sim 10^6 \times$ more than any per-entry input delivers (measured collective-cancellation gain 378–712); T-ENTRY is class (a); the surviving det-level form has $\kappa_{\max} = 0.0895 \ll 1$. *No five-line win*: 99.7% of atoms violate the pointwise Cauchy–Schwarz structure; *pret-breaks*: even a nonnegative pretentious measure drives $\det S < 0$ — the needed input is a pretentious-distance statement at the dual points. No marker move, no RH claim. Machine-checked: [verification/v683_rank3_functionals.py]. [E] (exact functionals, sieve cross-check) + (MEASURED) (circularity classes, CS/pretentious soundings) + [C] (typing)

The zero side of the rank-3 chain (PRIME.RANK3ZERO.01). Offensive 2b: the one determinant functional treated by the explicit formula — $D = \text{BND} - \text{RTERM} + \sum_{\gamma} z(\gamma)$, residuum $\leq 6.9 \times 10^{-6}$ on the reference window (22 491 budget-certified zeros to $T = 2 \times 10^4$, RvM checkpoints, the Lehmer pair resolved), with the exact per-zero envelope $|z(\gamma)| \leq 2C_G/\gamma^2$ (8 checks, ~ 15 s; verdict ZONE-PASS class (a)). *The unconditional kappa*: $\kappa_{\text{unc}} = 0.039$ – $0.190 < 1$ on all five declared windows — $\det S > 0$ from the identity + computed zeros + nothing else. *The zone mechanism quantified*: a zero at the dual points would couple at $3.2 \times \det M$; the largest real coupling is damped $\times 634$ by the classical zero-free strip $\gamma \geq 14.134$ (Gram/Hutchinson, unconditional) — the strip *is* the anti-pretentious input. Honest: T-B (absorption, $\sim 2 \times 10^{-5} \det M$) untouched; the missing uniformity quantifier named ($\rightarrow$ v685). No marker move, no RH claim. Machine-checked: [verification/v684_rank3_zeroside.py]. [E] (explicit-formula identity, budget-certified zero list; inverted firewall, declared input) + (MEASURED) (unconditional kappa, zone mechanism) + [C] (typing)

Closing the uniformity quantifier (PRIME.RANK3UNIF.01). Offensive 2c, the theorem-level result of the chain: $\det S > 0$ *unconditionally on the entire declared window surface* (8 checks, ~ 18 s; verdict SURFACE-CLOSED). *The statement*: for every complete window with $a \geq 3.434$ the symbolic envelope gives $K_{\text{env}}(a, h) \leq 0.9798 < 1$ (tightest at $h = 142$; 62 of the 67 complete family windows), hence $\det S \geq (1 - K_{\text{env}}) m' > 0$; the five windows below carry finite numeric certificates $\kappa' = 0.072$ – $0.108 < 1$. *The architecture*: exact U_0 rebooking $M' = M + \Delta$ (kills the 34:1 cancellation by definition shift), term-algebra-exact weights (sympy), mean-value envelopes (give-away $\leq \times 2.28$), det-minorant $m'/\det M' \geq 0.949$; inputs typed [E] + (A-CITED: $\gamma_1 = 14.1347$ Gram/Hutchinson; $\beta = 1/2$ to 3×10^{12} Platt–Trudgian 2021). *Honest scope*: a *surface* theorem on the declared family, *not* uniform in all a ; T-B (the absorption margin, **prob:R1**) stays open; no RH statement. Machine-checked: [verification/v685_rank3_uniformity.py]. [E] (symbolic envelope, rebooking identities, finite certificates) + (A-CITED) (zero-free strip, verification height) + [C] (honest scope)

The geometric SOS source (PRIME.GEOMSOS.01). Offensive 3, the first feasibility strike at the contract “ $Q_a^W(v) = \sum_j |l_{a,j}(v)|^2$ from TFPT geometry, without zeta, without zeros” (19 checks, ~ 19 s; verdict GEOMSOS-TRACE-EXACT-TRANSPORT-OPEN). *The circle-free trace* [E]: $\Lambda_{\text{geo}}(n) := \Lambda_L(n)/(1 + n^3) \equiv \Lambda(n)$ exactly for $n = 2.512$ (worst rel dev 7.1×10^{-31}) — the von

Mangoldt data reconstructed from E8 shell counting alone (Satake roots $\{1, p^3\}$ from the count $a(p) = r(2p)/240$; the Hecke recursion holds on raw counts; K1 passes). Cover-SOS on dim 3 canonical; the miniature window form is comb-validated (1.6×10^{-6}) and positive-definite there; K4 fires honestly (the certificate is window + comb, nothing more). *The gap*: top-3 eigenvalue mass = 91.4% — a pointwise rank-3 transport cannot suffice; missing H (bundle) and Φ (transport), registered as milestones M1–M4 of the contract with kill criteria K1–K5. No marker move, no RH claim. Machine-checked: [verification/v686_geometric_sos.py]. [E] (circle-free trace, canonical SOS) + (MEASURED) (miniature validation, eigenmass) + [C] (contract milestones, kill criteria)

The extremal kernel class collapses (PRIME.KERNELCLASS.01). Can an optimized positive band-limited kernel of the same exponential type lift the W2 capture threshold above $A_1 = 0.10076$? *Structure theorem*: no (18 checks, ~ 5 s; verdict KERNEL-CLASS-TOO-NARROW). *The pinning certificate* (EXACT): $2\pi F_{a_0}(m\pi/a_0) = 0$ exactly (sympy) forces the Fejér nodes on every admissible K , so $\theta_{\text{req}}(K) \leq 1/(4a_0) = 0.0901684 < 0.10076$ (strict interval certificate); *the collapse*: $\varphi_k(m\pi/a_0) = \delta_{km}a_0/2\pi$ exactly kills every free coefficient, and Shannon sampling (cited, typed ANALYTIC) extends to the full class: feasible set = $\{\lambda \text{ Fejér}\}$ — zero free directions. The LP ladder confirms ($z^*(N) \rightarrow \pi/a_0$ within 5×10^{-4}); the false-PASS trap is documented. W2 *stays closed* via the v680/v681 route — this negative shuts the kernel-optimization escape. No marker move, no RH claim. Machine-checked: [verification/v687_extremal_kernel.py]. (EXACT) (pinning + collapse, sympy) + (ANALYTIC, CITED) (Shannon closure) + (MEASURED) (LP ladder) + [C] (false-PASS typing)

The alias-interpolation falsifier (PRIME.INTERP.01). The calibrated off-line detector (v677 S3) turned into a complete, explicitly constructive falsifier (15 checks, ~ 9 s; verdict INTERP-FALSIFIER-CONSTRUCTIVE). *The guarantee*: the in-kernel matched filter detects every off-line quadruple from $2\alpha\delta \geq \Xi_{\text{up}} = 1.974$ ($C_{\text{up}} = 0.987$) on all mapped cells — efficiency median 0.500 vs the v677 mode map, a $\times 2$ improvement. *Masking fully adjudicated*: 46 broken + 2 provably sub-resolution = 48/48 masked configs (construction-open: 0) via the multi-construction menu. *The lemma*: formulated with measured constants (C median 0.499) and named building blocks (v678 node separation; Beurling–Selberg/Vaaler majorants via v680/v681). Inverted firewall (zeros = the declared hypothesis of every statement); no RH statement, no marker move. Machine-checked: [verification/v688_interpolation_detector.py]. [E] (master identity, sine form) + (E/MEASURED) (detection guarantee, masking adjudication) + [C] (lemma with measured constants)

The Hecke-SOS mechanism (PRIME.HECKESOS.01). Offensive 4: the prime-local, Hecke-equivariant factorisation $A = B^*B + P$ ($P \succeq 0$) with no zero input; six verbatim acceptance criteria adjudicated (27 checks, ~ 12 s; verdict HECKE-SOS-IHARA-MECHANISM-EXTRACTED). *The Ihara lab* [E]: the target factorisation exists *exactly* there — $A_{\text{IH}} = G_C + G_S$ with B the Chebyshev columns of the Hecke operator (recursion, no Cholesky, no spectrum) and $P = G_S$ the closed defect Gram; $P \succeq 0 \iff$ Ramanujan — the RH analogue sits in *one* operator inequality. *The index lemma*: the deployed ζ window form is exactly the sine/defect *half* of the canonical cos/sin split — the part whose lab positivity *is* the RH analogue (the cos half is unconditionally SOS). *The Euler mechanism measurable*: commensurable fake primes break exactly on the resonance lattice $2\pi j/\log 2$ (median dev 0.0000, 12/12) and deeper than matched jitter ($\times 1.98$; honest calibration (c): the razor-thin W3 margin dies under any $O(0.1)$ position damage). Controls: Epstein fails as demanded, the Ihara trio passes, scramble breaks. *The named gap*: Z1 — a self-adjoint geometric operator whose polynomial traces are the window moments (Hilbert–Pólya); Z2 would be RH itself: the factorisation *localizes* RH ($\rightarrow$ PRIME.Z1.OPERATOR.01, Offensive 5 running; sharpened 2026-08-05 with the measured qf handover constraints after the diagonal-Gram closure). No marker move, no RH claim. Machine-checked: [verification/v691_hecke_sos.py]. [E] (Ihara factorisation, index lemma; AST zero-firewall) + (MEASURED) (Euler resonance, Bochner sounding) + ([E], KILL) (Epstein/Ihara/scramble controls) + [C] (the named Z1 gap)

Typing T-B through the zero side (PRIME.RANK3LOCKGRAM.01). Offensive 2d: the deployed 2×2 lock block as an almost-collinear Gram matrix (7 checks, ~ 20 s). *The decomposition* [E]:

via the v677 master identity, polarized, $\hat{A}_2 = G_Z + P + \text{tail}$ per entry — a positive zero-Gram (per-zero psd rank ≤ 2 , Cauchy–Schwarz manifest per γ) plus a psd rank-1 pole layer $P = c_P s s^\top$ (closed form). *The margin identity* [E]: $\det(G_Z + P) = \det G_Z + c_P(s_\perp^\top G_Z s_\perp)$ — the razor-thin T-B margin is the transverse zero mass, a sum of squares (γ_1 carries 3–61%). *Superadditivity* [E]: on-line zeros only increase $\det$ (2×2 psd; zeros to 3×10^{12} on-line by citation) — the truncation is safe-side. *The typing* [C]: “*E kippt nicht*” is a quantified partial-RH tail statement — neither a 2c-envelope question nor a W3 renaming; census: 8/15 windows close at 3×10^{12} alone, 13/15 with the density route, remainder with exact factors and T^* up to 1.1×10^{16} . No marker move, no RH claim. Machine-checked: [verification/v692_rank3_lockgram.py]. [E] (decomposition, margin identity, superadditivity) + (A-CITED) (verification height) + [C] (partial-RH-tail typing)

Closing T-B(block) with cited density bounds (PRIME.RANK3DENSITY.01). Offensive 2e (5 checks, ~ 100 s). *The citation ledger* (A-CITED, exact forms): Platt–Trudgian 2021 (RH to 3×10^{12}), Hasanalizade–Shen–Wong 2022 (explicit RvM count), functional-equation halving, and the explicit Ingham-form zero density (arXiv:2507.15184, valid from exactly 3×10^{12}); Simonič honestly listed as trivial in range. *The refined envelope* [E]: sinh difference pairing, $V(0) = 0$ (near-line zeros harmless), on-line subtraction, Abel + Stieltjes tail — the penalty drops $\times 6.5$ –14.4 vs the 2d worst case. *The census*: 60/70 complete windows close *unconditionally-modulo-citations*; the exact remainder is nine windows with $T^* \in [1.0 \times 10^{13}, 3.0 \times 10^{13}]$ plus $h = 5690$ at 8.5×10^{14} ; extension beyond the family grows $\sim e^{3.74a}$. Honest scope: the lock-block determinant, not full W3. No marker move, no RH claim. Machine-checked: [verification/v693_rank3_density_close.py]. [E] (refined envelope) + (A-CITED) (four explicit citations) + (MEASURED) (growth law) + [C] (honest scope)

Closing the interpolation-lemma blocks (PRIME.INTERPCLOSURE.01). The two named building blocks of the alias-interpolation lemma made near-proof (20 checks, ~ 19 s; verdict CLOSURE-BOTH-NEAR-PROOF). (iii) *Retention* [E]: exact projection identity $\text{Im } \Phi_x(z_0) = \|(I - \Pi)m\|^2$ plus a closed-form $O(k^2)$ certificate; measured floor $r_f \geq 0.548$ on the family surface; the straddle boundary case discovered (a sub-resolution real pair collapses the pinned filter; the detector still fires via the barred $k = 0$ branch); Ingham 1936 covers the Gram at $q > 1$. (v) *Separation, form-corrected* (MEASURED): the pure law $\alpha^* = C'/\Delta\gamma$ is rejected; the additive law $\alpha^* = C_{\text{cell}}/\delta + C''/\Delta\gamma$ stands ($C''_{\text{up}} = 0.590$, zero exceptions in 97 tests, adjudication-tight); the two open parent configs detect at $\alpha^* = 7.90$; $C''(n=3) \approx 2 \times$ pair value = declared residue. An off-line zero is the hypothesis of every statement; no RH claim. Machine-checked: [verification/v694_interpolation_lemma_closure.py]. [E] (retention certificate) + (MEASURED) (additive separation law) + [C] (near-proof typing, named residues)

The Z1 measure from counting (PRIME.Z1MEASURE.01). Offensive 5, round 1 of the contract PRIME.Z1.OPERATOR.01 (25 checks, ~ 3 s; verdict Z1-MEASURE-FROM-COUNTING-OPERATOR-OPEN). *The candidate census*: seam (v621–v623) dead as Z1 spectrum (residuals ~ 1 , AP phases, $1/D$ drift); orbifold (v679) dead (null-calibrated); the E8 counting route delivers the Weil measure *exactly* — atoms from the shell recursion at deviation 0.0, arch/pole via the closed Γ -duplication split, $7/8$ target spikes at $q = 0.000$; must-fail: without the Satake projection the form breaks. *The precision* [E]: the deployed symbol is signed, but the comb sequence $c + \text{pole}$ is positive-feasible — the signedness is the pole subtraction. Kill criteria K-A..K-D preregistered (zeta/zero loading = renaming, AST-enforced). No marker move, no RH claim. Machine-checked: [verification/v695_z1_trace_operator.py]. [E] (measure identities, positive feasibility) + (MEASURED) (spikes, null calibrations) + ([E], KILL) (Satake must-fail) + [O] (operator missing)

The Z1 canonical operator (PRIME.Z1JACOBI.01). Offensive 5b: Verblunsky/CMV/Jacobi from the positive comb sequence (18 checks, ~ 1 s; verdict Z1-JACOBI-OPAQUE, with the strong renaming clause explicitly *not* confirmed). *Existence* [E]: the canonical CMV/Jacobi pair is built explicitly and reproduces all moments (worst rel dev 2×10^{-13}) — Z1 is now purely the closed-form question for the coefficients. *No closed law* (MEASURED): the two named first-order laws and the h -ladder fail. *But the counting signature is present*: features on prime-power slots ($q = 0.000$), amplitude–mass

link $r_{\log} = +0.76$, positivity load-bearing (smooth/scramble lose PD at $k \approx 170$, true masses PD to 2865). Ihara anchor: Kesten–McKay exact. No marker move, no RH claim. Machine-checked: [verification/v696_z1_jacobi.py]. [E] (canonical existence, moment back-verification) + (MEASURED) (law failures, counting signature) + ([E], KILL) (positivity collapse controls)

The Z1 transfer law (PRIME.Z1UVAROV.01). Offensive 5c: the slot-amplitude transfer machinery (14 checks, ~ 1 s; verdict Z1-UVAROV-SEQUENTIAL-CLOSED). *Duality proven* [E]: the atoms are lag insertions, not orthogonality-measure point masses (those sit at the zeros = the renaming direction, firewalled). *The exact identity* [E]: $\Delta\alpha_{m_0-1} = w_1/E_{m_0-1}$ (5.6×10^{-17} ; E the position-free Christoffel object), zero response below the slot. *The inverted stabilization law* (MEASURED): the Γ flow predicts the counting masses to $\sim 10\%$ (median ratio 1.026, corr 0.86) — the flow knows the masses. *Composition* [E]: sequential-exact with just-in-time positivity; every prime power individually load-bearing. No marker move, no RH claim. Machine-checked: [verification/v697_z1_uvarov.py]. [E] (duality, transfer identity, composition) + (MEASURED) (inverted stabilization law)

The Z1 flow recursion (PRIME.Z1FLOWREC.01). Offensive 5d: positions, residual, E-transport (15 checks, ~ 20 s; verdict Z1-RECURSION-SEMI). *Positions forced* (MEASURED): slot windows 0.5–2 cells (6/6 sharp), jitter null 30/30, adversary deficit -516 lags. *Shooting* (MEASURED): opposite divergence channels ($k \rightarrow \pm 1$) bracket the counting mass — recovery at the true position to 0.11% median; slot identity re-verified (9.4×10^{-14}). *Honest negatives*: autonomous reconstruction fails at greedy saturation (lookahead missing), residual noise-like, E-transport recursive — PRIME.Z1.OPERATOR.01 stays *open* (continuum reading missing). Zero-side read: firewalled correlation diagnostic only (AST-confined). No marker move, no RH claim. Machine-checked: [verification/v698_z1_flow_recursion.py]. [E] (slot identity) + (MEASURED) (forced positions, shooting) + [O] (lookahead autonomy, continuum reading)

Cone dynamics, killed honestly (QGEO.CONEDYN.01). The review-7.3 question — use the Lorentz form *dynamically* — executed on the prime-front determinant coordinates (18 checks, < 1 s; verdict CONE-DYNAMICS-DEAD). *The kill*: prime updates are *translations* in y -space (linearity exact), so no multiplicative cone-preserving semigroup; $\sim 99\%$ of increments are spacelike, ℓ not monotone on the true path — no Perron–Frobenius/Lorentz-boost reading survives. *Side finding*: the leaf functional separates scramble/Epstein where det is blind. The static cone results (v624/v627) stand untouched. AST zero-firewall; deterministic. No marker move, no RH claim. Machine-checked: [verification/v699_cone_dynamics.py]. ([E], KILL) (translations, spacelike census) + (MEASURED) (leaf-functional separation)

The keystone identity (PRIME.KEYSTONE.01). Cheap machine reads for “does the missing rest already sit in the corpus?” (11 checks, < 1 s). *The keystone* [E]: the deployed window form B is exactly the sine-moment form of $(c + \text{pole})$ plus a rank-1 pole square — the v695 measure route and the v677 master identity are one object; the three named gaps collapse onto *one* (defect positivity modulo operator). *Triplication* [E]: the arch is the mean of three digamma channels on the ζ_{12} grid, μ_3 -unique. *Kill*: V5 fixpoint numerology dead (PSLQ empty). No zeros read. No marker move, no RH claim. Machine-checked: [verification/v701_big_picture_hunt.py]. [E] (keystone, triplication) + ([E], KILL) (V5 numerology). *Lean round 5*: the finite algebraic kernel of the sine-Gram lemma (S1.1) is formally verified (SineGramKeystone.lean, kernel-checked, no sorry): the product-to-sum identity over an arbitrary commutative ring, the half-integer sine-moment form as an exact Gram matrix (PSD for nonnegative weights), with explicit Pythagorean certificates; the FFT limit and the deployed wiring stay numeric.

The lookahead decision (PRIME.Z1LOOKAHEAD.01). Offensive 5e: autonomous zeta-free comb reconstruction (13 checks, ~ 30 s; verdict FLOW-VERIFIER-NOT-GENERATOR). *Verification* (MEASURED): the full comb is flow-verified ($913 \geq 898$), every fake dies ≥ 184 lags earlier. *Generation limit* (MEASURED): beam search and global DP reach 2–4 slots; the per-slot demand $g \sim 5$ –12 bits is information-theoretic and parameter-robust. PRIME.Z1.OPERATOR.01 stays *open*. AST zero-firewall. No marker move, no RH claim. Machine-checked: [verification/v702_z1_lookahead.py]. (MEASURED) (verification, information limit) + [O] (continuum reading)

S-A: the circularity decider (PRIME.CHAINTOL.01). How sharply does the flow-induction constrain the masses? (10 checks, ~ 60 s; verdict TOLERANCE-RH-GRADE). *The kill*: the required per-step tolerance is RH-grade (over-RH on fine windows) — the tolerance induction is dead as a proof route. *The structure*: the Levinson recursion is an unstable shooting problem; the true comb is the unique bounded trajectory. AST zero-firewall. No marker move, no RH claim. Machine-checked: [verification/v703_chain_tolerance_scaling.py]. ([E], KILL) (tolerance induction) + (MEASURED) (shooting instability)

S-B: the G1 exactness hunt (PRIME.CHAINMASS.01). Does a closed formula predict the counting masses? (5 checks, < 1 s; verdict G1-OPEN). Seven closed laws censused; the best is C2 (next Levinson order): median 0.9947, IQR [0.9853, 1.0086], but max 0.3130 on soft slots — no closed law reaches the 0.1% bar; the residual strata are declared (soft/mid/tight 0.049/0.010/0.006). AST zero-firewall. No marker move, no RH claim. Machine-checked: [verification/v704_chain_mass_law.py]. (MEASURED) (closed-law census, declared strata) + [O] (G1 closed form)

S-C: the deck-sector anchor (QGEO.DECKSECTOR.01). The three digamma channels of the arch density *are* the three deck sectors of the 48-site NS lift (7 checks, < 1 s). *The identity* [E]: exact tower traces of the v623 deck sectors with the v628 twists $\{1/6, 1/2, 5/6\}$ reproduce the arch channel by channel at 3.4×10^{-16} ; the relative scalar is *forced* to 1; the must-fail control (wrong twists) is off by $\times 82$. The v701 triplication identity is closed *into* the geometry. GATE.QGEO untouched. No marker move, no RH claim. Machine-checked: [verification/v705_chain_deck_sector.py]. [E] (deck-sector trace identity, forced scalar, must-fail)

S-D: the Weyl characterization (PRIME.WEYLMASS.01). Is the mass law an m-/Schur-function evaluation? (10 checks, ~ 10 s; verdict WEYL-NUL). *The null*: point evaluation falsified (K2 median 0.3993, scramble-level corr). *The finds*: the flow α *are* the Schur parameters [E] (10^{-40}); the background breakdown sits exactly between the $n = 2/n = 3$ cell; the bare Γ flow knows $\log 2$ to 0.1–0.6%. AST zero-firewall. No marker move, no RH claim. Machine-checked: [verification/v706_chain_weyl_mass.py]. (MEASURED, NULL) (point evaluation) + [E] (Schur identity) + (MEASURED) ($\log 2$ find)

S-E: the section edge (PRIME.SECTIONEDGE.01). The closed form of the section-positivity edge (9 checks, ~ 10 s; verdict EDGE-EXACT-SELECTION-OPEN). *The identity* [E]: the edge is a resolvent (Christoffel–Darboux) identity, exact to 3×10^{-13} ; the full-ladder edge pins the mass to 2.6×10^{-4} . *The open piece* (MEASURED): the true mass sits at corridor position median 0.534, IQR [0.511, 0.559] — neither edge nor midpoint. AST zero-firewall. No marker move, no RH claim. Machine-checked: [verification/v707_chain_section_edge.py]. [E] (resolvent edge identity) + (MEASURED) (corridor census) + [O] (selection principle)

S-F: the position functional (PRIME.POSFUNC.01). Which functional fixes the ~ 0.53 ? (7 checks, ~ 110 s; verdict FUNCTIONAL-OPEN). The best of the preregistered families is the Levinson energy extremum E_{N-1} : median 0.9986, max 11.7%, and it *transports* across windows without a scalar; none reaches the 1% uniform bar. The outliers sit exactly on the prime powers 16/64/81 — the cells the v710 Hecke stage heals. AST zero-firewall. No marker move, no RH claim. Machine-checked: [verification/v708_chain_position_functional.py]. (MEASURED) (functional census, scalar-free transport) + [O] (uniform selection)

S-G: the layering diagnostic (PRIME.ZEROLAYER.01). Is the selection residual a zero layer? (10 checks, ~ 70 s; verdict LAYERING-REJECTED). Behind a *temporal* SHA256 firewall (residual hashed before any zero read), no tested projection finds a zero signature: best corr 0.042 = the scramble level; the von-Mangoldt-defect read is equally empty (-0.059); $\sim 64\%$ of the residual is window geometry. An honest diagnostic null for the record. No marker move, no RH claim. Machine-checked: [verification/v709_chain_zero_layer.py]. (MEASURED, NULL) (layering rejection, temporal firewall)

P1: the two-stage kill test (PRIME.TWOSTAGE.01). The two-stage Hecke selector for the G1 residual (7 checks, ~ 55 s; verdict P1-TWO-STAGE-DEAD). *The kill*: the memo bar fires (max

6.15% > 2%) — the composite closed law is dead as declared. *The surviving mechanism* [E]: the Hecke stage heals exactly the prime-power cells 11.7% → 0.53%, with circle-free channel detection from the E8 counting (Satake from shell counts). The remainder — first births on coarse windows — is measured in v711. AST zero-firewall. No marker move, no RH claim. Machine-checked: [verification/v710_chain_two_stage_hecke.py]. ([E], KILL) (memo bar) + [E] (Hecke healing)

P1b: the first-birth scaling (PRIME.FIRSTBIRTH.01). Fit-free measurement of the first-birth error under window refinement (7 checks, ~160s; verdict CONTINUUM-SELECTOR-MEASURED). Promotion-run power law $\theta = 1.851$ ($R^2 = 0.692$; bars $\theta \geq 0.5$, $R^2 \geq 0.6$; worker-run point estimate $\theta \sim 1.25/R^2 \sim 0.90$ — spread far inside the bars), ladder halves 2.736/1.520 both positive, 0/30 non-converging primes, the finest 6 windows carry 0 degenerate-horizon slots. A one-decade law; extrapolation typed (MEASURED). $G1 = [\text{E-edge}] + [\text{E-Hecke}] + [\text{M-rate}]$ complete. AST zero-firewall. No marker move, no RH claim. Machine-checked: [verification/v711_chain_firstbirth_scaling.py]. (MEASURED) (one-decade convergence law, typed extrapolation)

P4: the transverse strike (PRIME.RANK3TRANSV.01). Transverse scalarization × deck triplication for the ten open T-B windows (5 checks, ~65s). *The move* [E]: the v692 margin identity scalarized along the transverse direction (the penalty pays only the transverse zero mass) — median gain ×4.23 on the open ten; 69/70 **complete family windows close at the cited** 3×10^{12} ; the single remainder is $h = 5690$ with $T^* = 1.6 \times 10^{14}$ (down from 8.5×10^{14}). *The honest negative*: the deck lever is dead (triangle inequality). Zeros $\leq 2 \times 10^4$ in the margin only. T-B stays the conjecture. No marker move, no RH claim. Machine-checked: [verification/v712_rank3_transverse_deck.py]. [E] (transverse scalarization) + [A-cited] (explicit bounds via v693) + ([E], KILL) (deck lever)

The L1 montage (PRIME.L1MONTAGE.01). The first explicit assembly of the Z1 continuum candidate (16 checks, ~1s; verdict L1-ASSEMBLED-MEASURED). *The assembly* (MEASURED): deck-sector arch + lag-insertion atoms + pole subtraction — cover limit 6.2×10^{-8} , point masses at the D^2 rate, one UV slot. *The repair* [E]: the 5b negative was a normalization artifact. *The boundary*: divergence exactly at $s \leq 1/2$ — the critical line as the boundary of the construction, a consistency signature, *not* positivity. The missing theorems (self-adjointness, trace identification, positivity) are named — the trace/state/spectrum side has since been *measured* (v717–v719 below); the continuum Sätze stay open. PRIME.Z1.OPERATOR.01 stays *open*. AST zero-firewall. No marker move, no RH claim. Machine-checked: [verification/v713_l1_montage.py]. (MEASURED) (assembled candidate) + [E] (normalization repair) + [O] (continuum theorems)

The moonshot, stage 1 (PRIME.MOONSHOT.01). Is the atom layer groupoid-internal? (19 checks, ~10s; verdict MOONSHOT-GO). *The go* [E]: the primitive degrees of the $\mathbb{Z}[i]$ -E8 Hecke tower are *exactly* the Gaussian prime norms (maximality census, no prime projector); log generator + cell normalizer de-divisorize at 4×10^{-13} ; the σ descent matches 100 positions, 100 masses, 368 moments at 0.00. *Declared ingredients*: $\sqrt{n}$ half-density, σ descent. *The fence (typed)*: the finite counting facts are *E8-unspecific* — specificity and the arch gluing were stage 2 (PRIME.Z1.MOONSHOT.01), executed the same day (v716–v721 below). No marker move, no RH claim. Machine-checked: [verification/v714_moonshot_hecke_groupoid.py]. [E] (tower facts, descent) + [E]/MEASURED (stage 2 glue, v716) + [O] (specificity census as a theorem, ingredient derivation, continuum Sätze)

The moonshot, stage 2: the arch glues (PRIME.MOONSHOT.02). Does the archimedean place of the *same* groupoid deliver the arch tower? (18 checks, ~3s; verdict MOONSHOT-STAGE2-GLUED). One object, *one* normalization: the free 3-scalar LSQ returns $\kappa = (1, 1, 1)$ to $< 10^{-12}$ on all five windows. *Derived*: the $1/4$ in $\text{Re} \psi(1/4 + i\tau/2)$ is the μ_4 fixed-sector offset (exact trace identity, 1.4×10^{-10}); log π enters only through the declared self-dual UV cell (2.2×10^{-16}). Lift ladder $s^* \rightarrow 1$ at $\sim N^{-2}$ ($|s_\infty^* - 1| = 2.4 \times 10^{-7}$). *Must-fails*: μ_2 tower 0.326, wrong μ_4 class 1.000, wrong deck twists 0.474 — E8 forced *at the gluing*. Missing theorems named. No marker move, no RH claim. Machine-checked: [verification/v716_moonshot_arch_glue.py]. [E] (identities, gluing) + (MEASURED) (ladder rate) + [O] (groupoid trace formula, product formula, uniqueness theorem)

The moonshot, stage 3: the state (PRIME.MOONSHOT.03). Is the Weil functional a state on

the groupoid algebra? (21 checks, ~ 3 s; verdict STATE-ON-TRUNCATIONS). *Constructive*: Levinson PD on every truncation exhibits T as the GNS/CMV vector state (min headroom 0.76); binding identity at 10^{-12} . *The localized RH substance*: the naive tower reading misses by $|\Delta|/\text{W3-margin} = 104\text{--}1563$. *KMS*: detailed balance at $\beta = 1$ (Bost–Connes critical; half-density exponent $-1/2$ sharp). *Controls*: Ihara an exact state; Epstein breaks (Levinson depth 49/62). No marker move, no RH claim. Machine-checked: [verification/v717_moonshot_state.py]. [E] (state exhibition, identities) + (MEASURED) (Δ , KMS) + [O] (uniform symbol positivity = RH level)

The moonshot, stage 4: the spectrum (PRIME.MOONSHOT.04). Do the truncation eigenvalues converge to the zeros? (10 checks, ~ 33 s; verdict SPECTRUM-CONVERGES-MEASURED). Predictions SHA256-frozen *before* the declared target load; the operator stays zeta-free. $h = 1433$: 100.0% of 377 zeros at tol 0.25 (97.1% at 0.10, 84.1% at 0.05); rate -1.61 ; GNS K -ladder monotone $0.4678 \rightarrow 0.0003$. *Controls*: Ihara exact at finite K ; scramble dies as a state (depth 61); GUE light $\langle r \rangle = 0.6178$ vs 0.6189 (observation only). A measurement, not a theorem. No marker move, no RH claim. Machine-checked: [verification/v718_moonshot_spectral.py]. (MEASURED) (spectral convergence, firewalled) + [E] (control identities)

The moonshot, Satz-1 slice: the trace formula (PRIME.MOONSHOT.05). The trace formula of the glued object, term by term against Weil 1952 (24 checks, ~ 130 s; verdict SATZ1-LEDGER-EXACT). The finite trace formula is exact Gauss quadrature (1.7×10^{-11}); the term dictionary *closes*: pole $= \int \tilde{a} 2 \cosh(u/2)$ (1.7×10^{-13}), atoms = the classical prime term (1.8×10^{-15}), arch $= -\int \rho \tilde{a}$ (3.4×10^{-16}). $\Delta \rightarrow \Gamma'/\Gamma$ term + prime term classically ($\sigma = 1.000161$, $c = -10^{-4}$; the one-sided sum honestly has no limit). *Census*: of $\{\mathbb{Z}^8, E_8\}$ (Mordell 1938) only the Gaussian E_8 glues (8.5×10^{-17}). The new content sits exclusively in the convergence statements. No marker move, no RH claim. Machine-checked: [verification/v719_moonshot_traceformula.py]. [E] (finite trace formula, dictionary, census) + (MEASURED) (Δ rates) + [O] (convergence Sätze)

The moonshot, K2+K3 slice (PRIME.MOONSHOT.06). The two convergence theorems, measured and collapsed (14 checks, ~ 3 s; verdict K2K3-COLLAPSED-CLASSICAL). $K_3 \rightarrow$ measured tightness (compacta Cauchy; band edge under the smooth ω density; $p_0 = 0.981 \log(1/D) - 1.306$: sigma-finite, vague topology). $K_2 \rightarrow$ classical analysis on $s > 1/2$ (unconditional majorant, $c_{RS} = 1.03883$ verified in range; slowdown law slope $= -(s - 1/2)$ exact; discretization $\sim CD^2$). The boundary *exactly* $s = 1/2$ (Mertens slope 1.9994). Remaining hard substance: (L1) line identification + (L2) K1 node convergence. No marker move, no RH claim. Machine-checked: [verification/v720_moonshot_k2k3.py]. (MEASURED) (tightness) + [E] (majorant, slowdown law) + [O] (L1/L2)

The K1 capture lemma (PRIME.K1CAPTURE.01). The node-capture lemma behind stage 4, honestly adjudicated (14 checks, ~ 33 s; verdict K1-LEMMA-CAPTURE-ONLY). Markov–Stieltjes sandwich (0 violations), *symmetrized* Christoffel bound everywhere (run-1 honesty: unsymmetrized $w/\lambda = 1.9993$, fixed to the theorem), closed capture condition with certified radii; every synthetic peak (incl. a merged pair) captures; SHA256-frozen zeta-free. *The adjudication*: the certified radii sit $\sim 900\times$ above the measured errors — the lemma carries the *capture*, not the super-resolution; the precision is trace-formula content (K1b, exploration). Off-line honesty: the lemma presupposes $\mu \geq 0$ — capture lemma and v688 falsifier are two sides of the same positivity premise. No marker move, no RH claim. Machine-checked: [verification/v721_k1_node_capture.py]. [E] (capture chain) + (MEASURED) (adjudication) + [O] (super-resolution)

L1: determinacy classical, the wall typed (PRIME.L1IDENT.01). Identification of the vague limit via moment-problem determinacy (11 checks, ~ 2 s; verdict L1-DETERMINED-WALL-TYPED). The raw τ -measure does not carry the limit (naive moment slopes 2.254/4.245); in the Gauss-damped Weil frame the ladder moments identify against the closed geometric side (1.4×10^{-3} over $m_0..m_{16}$); Gauss/Freud band $[0.638, 1.117] \Rightarrow$ Carleman: *determined*, RH-free. The chain (a)–(d) closes with Weil 1952 (unconditional); the paradox resolves: “ T_h PD” is a *measurement* per h (scramble: Levinson death at depth 61). *The wall*: PD persistence — infinitely many PD windows suffice for RH; finitely decidable per window, measured 9/9; converse not shown.

Equivalent (Riesz–Haviland): the geometric side defines a positive measure on $\mathbb{R}$. No marker move, no RH claim. Machine-checked: [\[verification/v727_l1_identification.py\]](#). **[E]** (determinacy chain, identification) + (MEASURED) (PD 9/9) + **[O]** (the h -quantifier = the wall)

K1b: the super-resolution is atom pinning (PRIME.K1BPIN.01). Why do the nodes sit $\sim 900\times$ below the certified capture radius? (13 checks, ~ 31 s; verdict K1B-ATOM-PINNING; the two *preregistered* memo bars B1.1/B2.2 die honestly — the expected promoted outcome). The memo’s Christoffel-locality/asymmetry mechanism is *dead* (corr ~ 0 , direct first-order test included); the carrying mechanism is *atom pinning* of the raw measure (Nevai-type): lab rate $K^{-1.84}$, node-weight ratio $\rightarrow 1.03$, real-data correlate 0.64. Off-line pairs break *positivity* (Levinson death) instead of mislocating nodes — consistent with the v688 falsifier. SHA256-frozen zeta-free. No marker move, no RH claim. Machine-checked: [\[verification/v728_k1b_superresolution.py\]](#). (MEASURED) (mechanism adjudication) + **[X]** (memo mechanism) + **[O]** (raw atom structure = L1)

RP dead, bulk emerging, pinning supported (PRIME.RPUNIV.01). Three strategy-council measurements (5 checks, ~ 2 s; verdicts RP-DEAD-ON-TRUNCATIONS / UNIV-BULK-EMERGING / PIN-MECHANISM-SUPPORTED). Sector anatomy exact (pole Hankel-PSD, arch Hankel-NSD); the total fails plain *and* KMS-twisted reflection positivity (mineig/scale = -1.0): the naive OS route is dead — FE symmetry buys exactly the atom-free CC-2021 regime $|u| < \log 2$, no more. Gap-point sinc deviation halves along the K -ladder ($0.304 \rightarrow 0.150$); peak points not in the bulk class. One inserted Fejér peak reproduces the super-resolution scale (spacing/error up to $211\times$). Zeta-free. No marker move, no RH claim. Machine-checked: [\[verification/v729_strat2_rp_universality.py\]](#). **[E]** (sector anatomy) + **[X]** (naive RP) + (MEASURED) (bulk emergence, pinning lab)

The pinning lemma, certified (PRIME.PINLEMMA.01). The explicit lemma behind K1b (12 checks, ~ 29 s). L-PIN-1 (residual bound, Wilkinson-type) and L-PIN-2 (Kato–Temple; Parlett 11.7.1), one-line proofs; at an atom $K_K(x^*, x^*) \leq 1/m$ for all $K \Rightarrow$ bound $\sim \sqrt{\varepsilon/m}/K$ — exactly the measured K1b correlate. 0 violations: synthetic scan (54 configs) *and* real windows — 598 peaks, 535 matched band zeros incl. *all* 377 of the largest window (SHA256 freeze before the target load). Comb coherence is not the mechanism (flatness 1.05). *Saturation*: the certificate stops at the window resolution at every K (certified $5.3 \times 10^{-1} \tau$ vs measured $2.2 \times 10^{-4} \tau$) — sub-width certification needs atomicity beyond every window depth = L1, sharply localized. No marker move, no RH claim. Machine-checked: [\[verification/v730_strat2_pinning_lemma.py\]](#). **[E]** (lemma pair, 0 violations) + (MEASURED) (exponents, saturation) + **[O]** (L1 atomicity)

Gap universality: strong form killed (PRIME.GAPUNIV.01). The gap layer on the finer K -ladder, zeta-free (5 checks, ~ 1 s; verdict GAP-UNIV-KILLED). The median sinc-shape deviation plateaus at 0.33 ($0.568 \rightarrow 0.389 \rightarrow 0.284 \rightarrow 0.332$; best point 0.15) — the preregistered kill bar fires. Regularity proxy monotone to cap = 1 (0.9995); fixed- h gap floor positive on all 9 windows; but the uniform-in- h Szegő condition breaks like $h^{-0.64}$: the h -limit gap layer runs through the atomic limit (= L1). Remains: a fixed-window *conditional* candidate (Lubinsky 2009; Levin–Lubinsky 2008; Avila–Last–Simon 2010; Totik 2009). No marker move, no RH claim. Machine-checked: [\[verification/v731_strat2_gap_universality.py\]](#). **[X]** (strong measured form) + (MEASURED) (condition ladder) + **[O]** (conditional fixed-window theorem)

Sonin compression: the direct transfer dies (PRIME.SONIN.01). Finite Sonin–prolate compression on the windows (21 construction checks, ~ 17 s; verdict SONIN-RANK-GROWS, the preregistered kill). One-cell self-dual projections ($2U_0T_0/\pi = 1$ exactly), odd sector, whitened defect analysis (rank bound verified, reconstruction 2×10^{-10}). Bad rank grows $19 \rightarrow 86$ (bar ≤ 4); defect excess $\rightarrow 1.3 \times 10^5$; one E_8 /pole condition neither stable nor sufficient. *Fence*: kills the chosen cutoff on *these* truncations, not the Connes–Consani mechanism (atom-free adelic regime); retuning forbidden. No marker move, no RH claim. Machine-checked: [\[verification/v732_strat3_sonin_prolate.py\]](#). **[E]** (construction) + **[X]** (direct CC transfer)

Gate 0: the weak functor into Connes’ algebra (PRIME.GATE0.01). The $S = \{\infty, 2, 3, 5\}$ orbit-algebra census (13 checks, ~ 1 s; verdict GATE0-WEAK-FUNCTOR). Non-tautological input from

the Gaussian HNF tower (place 2 ramified / 3 inert / 5 split); HNF-cell division + σ -orbit quotient leave $\kappa \equiv 1$ at all three places. On the finite Laurent basis all 6859 convolution coefficients agree with deviation 0 (integer/Fraction exact); involution, grading/time action, regular *and* closed-orbit traces preserved. *Not proved*: extension to the full S -local convolution algebra (topology, adeles, isotropy, KMS). No marker move, no RH claim. Machine-checked: [\[verification/v733_strat3_gate0_census.py\]](#). **[E]** (exact census, $\kappa \equiv 1$) + **[O]** (full-algebra extension)

S1: the canonical system and the Suzuki bridge (PRIME.S1CANON.01). The wall in the fourth language (10 checks, ~ 1 s; verdict S1-CANONICAL-SUZUKI-BRIDGED). Krein correspondence *exact*: rank-one canonical steps from the Jacobi/Wheeler data (nilpotency 3.1×10^{-16}), Weyl identity to 1.6×10^{-15} (4 complex $z \times 9$ windows). $H_h \geq 0$ *measured*: $\min l_k = 0.033..0.377$, all positive. Gauge-invariant data Cauchy (disks collapse with rate); bulk node density is equilibrium ($c_1 = 0$, honest negative partial finding); the *boundary phase* carries the γ -side at scale exactly 1 ($1.9\text{--}2.5 \times 10^{-2}$). Scramble breaks the Wheeler/Krein chain at depth 31. *Suzuki bridge* (JFA 281 (2021)): GRH $\equiv$ positivity of the canonical family, unconditional only $\omega > 1$; our truncations are the first computable zeta-free family with measurable $H \geq 0$ — the fourth language of the PD-persistence wall (with v727). No marker move, no RH claim. Machine-checked: [\[verification/v734_s1_canonical.py\]](#). **[E]** (Krein correspondence) + (MEASURED) ($H_h \geq 0$, boundary phase) + **[O]** (the h -quantifier)

L1 state transport: the UCP route, honestly closed (PRIME.UCPLIMIT.01). Covariant UCP maps along the nine-window GNS ladder (10 construction checks, ~ 1 s; verdict UCP-STAGNATES). The construction is *exact*: each simple-spectrum GNS shift generates $C^*(J_h, \mathbf{1}) = \mathbb{C}^h$, so a UCP map is a row-stochastic transport kernel and the Choi SDP reduces to a finite transport LP — all eight adjacent maps exist canonically as monotone quantile couplings (unitality/state preservation $\leq 3.1 \times 10^{-12} / 1.2 \times 10^{-15}$, Choi minimum 0), every Choi rank inside the sharp bound $h + h' - 1$ (ranks 344..2688, log-log slope 0.991 vs bar 1.25: linearly controlled). The preregistered covariance gate *fails honestly* (error tail not monotonically decreasing): mere state transport is *not* the missing L1 mechanism. The optimal maps are quantile Markov couplings, not $*$ -homomorphisms (multiplicativity defects $\sim 5\text{--}8 \times 10^{-3}$); the full noncommutative groupoid algebra was not tested. This closes the L1 route portfolio: Sonin dead (v732), UCP stagnates (v735), Gate 0 weak functor (v733), Suzuki bridge a measurement (v734). No marker move, no RH claim. Machine-checked: [\[verification/v735_strat3_ucp_inductive.py\]](#). **[E]** (exact UCP/transport construction) + (MEASURED, honest negative) (covariance gate)

The ramified Hecke fiber and the seven channels (PRIME.HECKEMODRAM.01). The Gaussian- E_8 Hecke tower projected onto $V = L/(1+i)L$ (34 checks, ~ 2 s; verdict HECKE-MOD-RAMIFIED-CHANNELS). The projection is exhaustively well-defined and σ -functorial over all 5907 submodules (no kill); odd layers act as degree $\cdot \text{id}$ ($156/156/820/2380/2380$ — the fiber is Hecke-rigid); the ramified layer *is* the 15 hyperplanes of V with the 2:1 deck. Channels: 3 fixed + 4 moved = 7 σ -orbit channels +1 trivial (resolving 7-vs-8); NS/R = the σ -fixed parity character (v722 re-derived; 7 NS + 8 R); ram-odd ($n = 2, 8, 32, \dots$) is the unique negative-pressure channel. Honest boundary: the W3 margin is cross-channel cancellation — no transfer-matrix reduction from the projection alone. No marker move, no RH claim. Machine-checked: [\[verification/v738_hecke_mod_ramified.py\]](#). **[E]** (exact finite Hecke/submodule census) + **[C]** (the W3 boundary typing)

The rank-3 jet simplification: dead (PRIME.RANK3JET.01). The review's first-jet reading of the rank-3 wall, tested exactly (20 checks, ~ 3 s; verdict RANK3-JET-DEAD). The jet read *is* exact: the lock block is the first jet of one function to 4.6×10^{-16} (Loewner coordinates), and on the odd sector $[1 - r_{12}^2]_{\text{odd}} = \frac{3}{8} S[\tilde{g}](1) \varepsilon^4$ (the Schwarzian form). But the review kill fires: the ε^0 coefficient is identically 1 (not 0), the even sector exceeds the net entry ($1.15\text{--}6\times$), the pure jet block carries no collinearity (factor $\geq 1.9 \times 10^3$) — the third power is even/odd *compensation* (T-B substance), not a jet identity; class (c) for the envelope route; KREIN-LINK-WEAK (correlation 0.678 vs control 0.946). No marker move, no RH claim. Machine-checked: [\[verification/v739_rank3_jet.py\]](#). **[E]** (exact jet algebra) + (MEASURED) (even-sector kill, honest negative)

The KMS extension switch: the strong form is dead (PRIME.KMSEXT.01). The strongest literal reading of the review master contract, tested before any global construction (8 construction/control checks, ~ 1 s; verdict KMS-EXTENSION-DEAD). The strong form dies twice, algebraically: $\beta = 1$ KMS is impossible on Gate-0's nonzero-grade Laurent unitaries — $T(u_p u_p^*) = 1$ versus $T(u_p^* \sigma_i(u_p)) = 1/p$, exact defects $1/2, 2/3, 4/5$ at $p = 2, 3, 5$ — and adjacent normalized GNS states are *not* restrictions along covariant unital $*$ -embeddings (0 of 141..1255 required exact boundaries). What survives: local extended Gram positivity on the 55,296-monomial factorized slice per window ($\lambda_{\min} 5.0 \times 10^{-11}..7.3 \times 10^{-9}$ vs random $\sim 8 \times 10^{-2}$). Controls fire (Epstein 17 negative sites; scramble). The weaker contract is named: BC semigroup Toeplitz algebra + operator-system maps. The two [FAIL] lines are the preregistered kills. No marker move, no RH claim. Machine-checked: [\[verification/v740_kms_extension_switch.py\]](#). [E] (exact algebraic kill + local positivity construction)

The BC Toeplitz correction and the covariance kill (PRIME.KMSTOEPLITZ.01). The Bost–Connes semigroup slice of the master contract (9 construction/control checks, ~ 1 s; verdict KMS-TOEPLITZ-DEAD). The BC isometry correction repairs the algebraic KMS obstruction *completely*: the boundary-corrected KMS identities are exact (normalized bare error $10^{-2} \rightarrow 10^{-9}$ along the directed Toeplitz system); arch/isotropy KMS passes; window Grams stay positive; UCP state transport exists (3.1×10^{-12}). But the covariant inductive contract stays dead (preregistered): the UCP window-covariance errors are nonmonotone (0.797..1.558..0.058). Final form: keep the proven BC-Toeplitz local KMS blocks; state the global handoff as operator-system compactness (PRIME.KMS.INDUCTIVE_STATE.02). Literature anchor: $\beta = 1$ KMS for the genuine BC algebra is classical (Bost–Connes 1995). No marker move, no RH claim. Machine-checked: [\[verification/v741_kms_toeplitz_semigroup.py\]](#). [E] (exact BC-Toeplitz KMS repair) + (MEASURED) (covariance kill, honest negative)

The channel interference anatomy (PRIME.CHANNELINT.01). The cross-channel dissection of the thin W3 margin (14 checks, ~ 5 s; verdict INTERFERENCE-COLLECTIVE). The margin is *one* collective scalar balance — arch + ram-odd against split + inert — strictly monotone over all 35 deployed windows (consecutive cosine ≥ 0.9961 ; all five balance components monotone). Two exact Ward identities: the cross components cancel exactly on every window ($\sum c = 0$ to 1.8×10^{-15}); the 8×8 rigid block equals $\dim_C \dim_{C'} m_0$. No pair reduction ($k_{95} \in [4, 5]$, $k_{\text{pair}90} \in [6, 8]$); scramble fires ($\times 2 \times 10^3$ – 3.9×10^6). The channel basis is diagnostic, not reductive. No marker move, no RH claim. Machine-checked: [\[verification/v742_channel_interference.py\]](#). [E] (exact Ward identities) + (MEASURED) (collective balance anatomy)

The cone-preserving Schur recursion: dead (PRIME.SCHURCONE.01). The review's layer-recursion thesis, killed by a one-liner (7 checks, ~ 1 s; verdict SCHUR-CONE-DEAD). The machinery is exact — Moebius/Schur update at 2.9×10^{-41} (Fraction arithmetic), T^*JT identity exact — and then: a layer map is cone-preserving *iff* the layer is positive ($c_0 \geq 0$), and no prime layer is ($c_0 = 0$ exactly, with genuinely negative dips). “ $T^*JT \leq J$ per layer” cannot carry in principle; the escape — a canonical positive re-bundling — is itself an RH-class statement and the precisely named missing piece. No marker move, no RH claim. Machine-checked: [\[verification/v743_schur_cone_recursion.py\]](#). [E] (exact machinery; one-liner kill — honest negative)

Channel columns for the Hecke SOS (PRIME.CHANNELSOS.01). The follow-up strike of the SOS offensive with the ramified-fiber channels (15 checks / 0 failures, ~ 7 s; verdict HECKE-SOS-CHANNELS-PARTIAL). No canonical column choice factorizes the window Gram: the cos-half candidate is indefinite, and the PSD- B^*B completion consumes 5–6 orders of magnitude beyond the W3 margin. The coherent failure is the structural finding: the Ihara *channel* route fails exactly as for ζ (the operator route passes: trio PSD, prisms break) — channels grade *positions*, positivity lives in *frequencies*. Finiteness measured: $\dim V = 16$ carries ≤ 16 spectral frequencies, the windows need 168–862. Epstein fails doubly; scramble breaks. No marker move, no RH claim. Machine-checked: [\[verification/v744_hecke_channel_columns.py\]](#). (MEASURED) (factorization negatives; coherence controls exact)

The tower as a confluent multiway system (E8.MULTIWAY.01). The Zuse/Wolfram reading of the Hecke tower, measured (24 checks, ~ 5 s; adjudication MIXED). The diamond is exact: multiway confluence = Hecke commutativity = CRT (a theorem). The one new fingerprint: the branchial graph at the prime places has spectrum $\{1, q+1\}$ with the $[4, 2]_q$ Grassmann cell count. Λ recursion = causal path statistics (v714 renamed). Adjudication: A1 tower=multiway and A3 irreducibility ($\lambda = \ln g \in [1.70, 2.48]$ nats/slot; testable log-scaling N^*) *equivalently useful*; A2 lift=CA and A4 code=DFA *renamings*. Not a standalone research program, not a pure narrative layer. No marker move. Machine-checked: [verification/v747_automaton_multiway_tower.py]. [E] (exact confluence/branchial census; typed adjudication)

Sigma-orbifold confluence (E8.ORBIFOLDCONF.01). The orbifold sequel (15 checks, ~ 42 s; adjudication EQUIVALENTLY-USEFUL). Two-line lemma: σ is a multiway *automorphism*, so the σ -quotient is confluent *everywhere* — including the ramified place. What actually breaks is only the half-orbit *weighting* (the mass convention on half orbits) — exactly at the ramified place, same *location* as $[D, A]$, not the same object. The multiway reading falls back exactly onto the known structure (confluence = CRT; branchial = Grassmann cells; irreducibility = v702) and rests as documented exploration, with one reference sentence in the introduction's Zuse positioning. No marker move. Machine-checked: [verification/v748_automaton_sigma_orbifold_confluence.py]. [E] (exact confluence lemma; typed adjudication)

The nested tower reduction (PRIME.TOWERNEST.01). The structural upgrade of the PD-persistence formulation (8 checks, ~ 1 s; verdict TOWER-NESTED-REDUCES). The window quantifier reduces *exactly* to the canonical nested (D, X) tower: X-nesting exact to 6.7×10^{-18} (limit positivity = one limit object per chain); dyadic D -refinement exact (PD fine *forces* PD coarse); every deployed window a tower member at deviation 0.0. Box step functions are dense, so tower-PD for $D \rightarrow 0, X \rightarrow \infty$ is equivalent to the Weil criterion (classical density step) — the canonical truncation replaces the historical window family in PRIME.PD.PERSISTENCE.01. Honest limits: incommensurable root- D chains connect only approximately; the margins fall along the tower. No marker move, no RH claim. Machine-checked: [verification/v749_simpler_tower.py]. [E] (exact nesting/inheritance reduction; honest limits typed)

The gluing detector (PRIME.GLUEDTECT.01). The gluing-rigidity hope, honestly resolved (5 checks, ~ 1 s; verdict GLUING-DETECTOR). The gluing identity is an identity-level *off-line detector*: it sees $\delta = 0.01$ — sharper than the PD break at $\delta^* = 0.02$ — and the envelope slope measures δ . The rigidity thesis is honestly *false*: the identity holds unconditionally (both sides are constructed); what a proof lacks is that the true lags can only be carried by an on-line spectrum — that *is* positivity itself. As diagnostic, superior to the PD channel; no new RH access. No marker move, no RH claim. Machine-checked: [verification/v750_simpler_gluing.py]. [E] (exact detector construction; rigidity thesis falsified — honest negative)

Monotone Ward running (PRIME.WARDMONO.01). The Ward-monotonicity hope, dissected (15 checks, ~ 3 s; verdict WARD-MONOTONE-MIXED). The deterministic part carries 100%: component running deterministic in direction with parameter-free ζ/L constants; the $\mp u/2$ drift anatomy exact (from $p^2 \equiv 1 \pmod{4}$); slope-Ward cancellation at 4×10^{-4} — the margin inherits *zero* deterministic drift. The honest kill: the balance *sign* is zero content — the deterministic budget is $2.9 \times 10^4 \times$ the margin; a provable sign would need the local zero fluctuation of ψ to $\sim 10^{-6}$ relative accuracy — the induction route for $\lambda_1 > 0$ is RH-circular at the balance level. Shape provable, sign not. No marker move, no RH claim. Machine-checked: [verification/v751_ward_monotone.py]. [E] (exact drift anatomy) + (MEASURED) (deterministic running; circularity typing)

The polarity match (PRIME.HECKEPOLARITY.01). The Hecke layer *is* the geometry (25 checks, ~ 1 s; verdict POLARITY-MATCH). The 15 ramified Hecke hyperplanes (v738) are exactly the $\bar{h}$ -orthogonal spaces; canonical bijection $y(\varphi) = \bar{G}^{-1}\varphi$ (canonical-linear, not the identity); σ -functorial; deck and parity bit commute (χ descends to every fiber). Canonicity census: of 64 alternating forms, 28 nondegenerate, exactly *one* σ -invariant = $\bar{h}$ — the hermitian derivation fixes one form without

choice. Controls fire. No marker move. Machine-checked: [\[verification/v753_ramified_polarity.py\]](#). [E] (exact census/bijection)

The real two-step channel (PRIME.HECKETWOSTEP.01). The down-up pass is the depolarizer (19 checks, ~ 1 s; verdict TWOSTEP-EXACT). The normalized $n \rightarrow 4n$ two-step transport of the real ramified odd layers is *exactly* $K^2 = (4/49)I + (45/49)\Pi_0$; degree factor $196 = (2 \cdot 7)^2$ closed (deck factor $4 = (1 + i)^2 \cdot \mathbb{Z}/2$ of both legs); $T = 4B^2$; KMS half-weight the closed factor $1/2$ per pair, exponent-exact, no free scalar; the same integer matrix on all 9 contexts; spectrum of $T/196$: 1, $4/49$ ($\times 14$), contraction gap $45/49$; σ -covariant, cone-preserving (strict Perron–Frobenius). Honest boundary: naive edge-label chains do *not* carry K^2 — the correspondence composition is mandatory. Controls fire. No marker move, no RH claim. Machine-checked: [\[verification/v754_ramodd_twostep.py\]](#). [E] (exact integer transport identity)

The ramified Schur recursion (PRIME.SCHURREC.01). The induction frame that fits the wall (13 checks, ~ 1 s; verdict SCHUR-RECURSION-ALIVE). $S_k \succeq 0$ *measured* on all 8 ram-odd stages of the tower nesting ($n_k = 2^{2k+1}$; $\lambda_{\min}$ flat, long-double-hardened); Douglas trivial; the frame stands: basis + Douglas + Albert/Haynsworth + cofinality all exact — the open proof need is exactly the structural Gram certificate $S_k = R_k^T R_k$ per step. Measured boundary data: the label part enters *inverted* ($\rho_k < 0$, $|\rho_7|$ near $49/4$ within factor 1.34 — cross-term structure), continuum vs atoms order-1 comparable. Honest: for ζ data equivalent to tower PD. Controls break immediately (scramble -4.7×10^3 , Epstein -5.0×10^2 at $k = 0$). No marker move, no RH claim. Machine-checked: [\[verification/v755_simpler_schur_recursion.py\]](#). [E] (exact frame) + (MEASURED) (ladder positivity; equivalence typing)

The covariant Stinespring extension (PRIME.KMSSTINESPRING.01). Step 3 solved on the ramified layer (7 checks, ~ 1 s; verdict KMS-INCIDENCE-CP-COVARIANT). 105 explicit Kraus terms realize $K = B/7$ as a CP unital map ($\sum V^*V$ dev 3.3×10^{-16} , K to 2.8×10^{-17} , Choi PSD); all four compatibilities exact: σ -covariance 0, half-weight $DU = 2^{-1/2}UD$ to 1.1×10^{-16} , $\beta = 1$ detailed balance to 6.9×10^{-18} , Gate-0 to 3.3×10^{-16} . Local candidate state $\tau_{\text{inc}} \otimes \tau_{\text{Toeplitz}}$; the remainder to a global state named (places/levels, arch lift, canonical UCP window map, compactness, Weil identification) — exactly the compactness step of PRIME.KMS.INDUCTIVE_STATE.02. [2026-08-04, the diagonal gram round: that compactness step now carries measured handoff evidence and an abstract Lean closure — see the handoff blocks below ([\[verification/v766_handoff_bulk.py\]](#), [\[verification/v767_handoff_frequency_gram.py\]](#), [\[verification/v768_handoff_tail_weil.py\]](#); `GramCompactness.lean`); the surviving open object is the q_f wall of [\[verification/v763_yosida_handoff.py\]](#).] [2026-08-05, the q_f offensive: the q_f object is adjudicated — representation gauge with a dead corner-native Gate 3' (v769), settled-positive levels (v770), a moving spectral edge (v772), and a domain-only cell cocycle (v773) — see the five audit blocks below; PRIME.GRAM.DIAGONAL.01 is closed per its own frozen stakes and the compactness remainder hands over to the sharpened PRIME.Z1.OPERATOR.01.] Control fires. No marker move, no RH claim. Machine-checked: [\[verification/v756_kms_incidence_stinespring.py\]](#). [E] (exact Kraus construction with exact covariances)

The certificate keystone (PRIME.CERTROOT.01). The assembled certificate is not mountable (8 checks, ~ 1 s; verdict CERT-CONTINUUM-ROOT-DEAD). The review shape [continuum root $\oplus$ Kraus] fails on every stage: the arch+pol block is PSD *nowhere* ($\lambda_{\min}$ $-4.9 \times 10^{-3} \dots -3.6 \times 10^2$, Levinson break at cell 47, exactly between the $n = 2$ and $n = 3$ cells, ladder-wide — v706 reproduced and sharpened); the continuum Schur complement is no Haynsworth object; the additive split fails (the order-1 balance sits in the cross-term); the rescue cascade is strictly cell-ordered (only the full family is PD). The wall *is* the missing left factor. What remains: the exact building blocks (v752–v756) and the corrected target shape — cell-wise cascade factorization, rescue order $n = 2, 3, 4, 5, \dots$ across the channels — named in PRIME.PD.PERSISTENCE.01. No marker move, no RH claim. Machine-checked: [\[verification/v758_simpler_certificate.py\]](#). [E] (exact anchors) + (MEASURED) (ladder-wide negatives; keystone typing)

The local bulk covariance decider (PRIME.HANDOFFBULK.01). Modul 1 of the global-handoff offensive (17 checks, ~ 1 s; verdict HANDOFF-BULK-CONVERGES). The ε -regulated resolvent $G^\varepsilon = (A_X + \varepsilon I)^{-1}$ is the admissible operator-system evaluation; circle-free weak-* form (rung Cauchy increments on the SHA-frozen battery, no $X=\infty$ reference, no zeros): all 9 (ε, R) cells pass — rates $b = 0.174\text{--}0.310$ per X unit, ε -robust over three decades. The bare A^{-1} does *not* stabilize (+45%; the named negative block — an unbounded observable); the layer decomposition is a cancellation balance (leading channel up to $1.9 \times 10^{12} \times$ the total defect). Controls break on all rungs; PD-enforced scramble has $b = -0.927$. The $\varepsilon \rightarrow 0$ wall stays at the spectral edge, quantified. No marker move, no RH claim. Machine-checked: [\[verification/v766_handoff_bulk.py\]](#). [E] (exact Ward/freeze machinery) + (MEASURED) (ε -robust rates; wall quantified)

The growing-frequency source Gram (PRIME.HANDOFFGRAM.01). Modules 2+3 of the offensive (6 checks, ~ 4 s; verdict HANDOFF-GRAM-CONVERGES). The PSD-by-construction frequency source Gram (Q byte-hashed before any target): Candidate A missed the frozen rate gate honestly (cell count below the anti-alias degree, slope +0.471 territory); the predeclared Candidate B ($N_f = 2M+1$) converges — spectral errors $0.0855 \rightarrow 0.0377$ over $\dim Q$ $738 \rightarrow 5734$, slope -0.369 ; min symbol $+7.4 \times 10^{-3}$; final layer errors arch 0.0141 / atom 0.3946 / pole 0.4144 (the paired-cancellation anatomy). Both controls fire. No marker move, no RH claim. Machine-checked: [\[verification/v767_handoff_frequency_gram.py\]](#). [E] (frozen construction) + (MEASURED) (convergence profile)

The tail, the compatibility, the Weil identification (PRIME.HANDOFFTAIL.01). One module from two probes (gates 11/13 + 4/4; verdicts TAIL-WEIL-PARTIAL+COMPAT-EPS3-CONVERGES). The quadrature tail *terminates algebraically* (alias census $(M-1) + \text{spread} \leq 2M$ on all 5 windows, max tail 2.4×10^{-13} : no quadrature tail exists); all layer slopes -0.365 , atom+pole a $10.5 \times$ cancellation pair; Weil identification on the frozen battery $\kappa = 0.97768 \rightarrow 0.99028$ within 0.0485 (battery-limited). The two frozen $\varepsilon = 10^{-3}$ endpoint fails of part 1 pass the fresh preregistration on the deepest 36-rung ladder under the oscillation-aware statistic ($b = 0.178/0.186$, med5 $0.343/0.467$, $b_2 = 0.069/0.096$); first wall sign at $\varepsilon = 3 \times 10^{-4}$ ($b_2 = -0.011$, reported never gated). Controls fire. No marker move, no RH claim. Machine-checked: [\[verification/v768_handoff_tail_weil.py\]](#). [E] (algebraic tail termination) + (MEASURED) (identification/compatibility; part-1 PARTIAL on record)

The fixed-window resolution classifier (PRIME.HANDOFFRES.01). Gate 1 of the diagonal Gram round (8 guards, ~ 8 s; verdict RESOLUTION-BOUNDARY, Fall B on all three windows). E_{total} is constant in q to 15 digits under $N_f = q(2M+1)$, $q \in \{1, 2, 4, 8\}$ (max drift 7.0×10^{-14} vs the frozen 10^{-7}); alias increments pure rounding. The remaining handoff error is boundary/cutoff/object-gluing, carried by the paired atom+pole channel. No marker move, no RH claim. Machine-checked: [\[verification/v759_handoff_fixed_window_resolution.py\]](#). [E] (q -invariance at rounding level) + (MEASURED) (classifier)

The anti-alias exactness theorem (PRIME.ANTIALIAS.01). The corrected sharp count (14 guards, ~ 7 s; verdict ANTIALIAS-CORRECTED). Exact identities for *arbitrary* M -cell coefficients (Parseval 2.0×10^{-14} , moments 3.5×10^{-13} , Gram 5.9×10^{-13}); the exact alias formula $t_d = \sum_r (-1)^r \hat{s}(rN_f - d)$ at every ladder count; the designed must-fail witness at $N_f = 2M-2$ fires with error exactly 1. The sharp minimal count is $N_{f,\min} = 2M-1$ (spread- S : $M+S$) — corrected *downward*; the deployed $2M+1$ stays exact, nothing patched. Companion Lean module `AntiAliasExact.lean` (19 general- N theorems). No marker move, no RH claim. Machine-checked: [\[verification/v760_antialias_exact.py\]](#). [E] (exact quadrature identities; Lean companion)

The paired Abel transformation (PRIME.ABELPAIR.01). Gate 2, one module from two probes (24+10 checks; combined adjudication ABEL-PAIRED-BOUND). Stieltjes/Abel split exact (6/6 sympy certificates); matrix identity to 1.45×10^{-11} on all 5 windows; E_{origin} closes via the W1/Suzuki bookkeeping (comb-independent). The unconditional bound $\eta_K = |\det_K| + |\Theta_K(0)E(1)| + B_1 I_K$, $B_1 = 3.734$ on the finite range $[1, 24.29]$, holds for all 24 kernels on all 5 rungs with pure $1/\log X$ decay — no RH-strength input (the circularity flag is machine-checked). The companion derives

the correct breaker standard: Epstein breaks at $2.95\times$ the envelope (7/24), scramble at $262\times$, the truth passes 24/24; the parent's frozen ABEL-DEAD stays on record as the calibration lesson. Honest typing: identity and slope-1 normalization are measure-generic; the certified ζ -specificity is envelope quality + measure positivity. No marker move, no RH claim. Machine-checked: [verification/v761_atom_pole_abel.py]. [E] (exact identities) + (MEASURED) (unconditional finite-range bound; derived control standard)

The canonical dense core (PRIME.DENSECORE.01). The test space, certified (26 checks, ~ 2 s; verdict DENSE-CORE-CANONICAL). The countable dense family of dyadic boxes/hats of the (D, X) tower: frozen enumeration (bijection certified on $n < 10^5$), explicit stage map, I_{64} exact in $\mathbb{Q}$; admissibility located per class (hats direct, slope -1.854 ; the bare box fails the r^{-2} criterion — named caveat — and enters only correlated/tent-read); density rates hat -1.566 / box -0.503 per level; exact $\mathbb{Q}$ correlation closure on 8/8 type pairs; the 24 battery an initial diagnostic package (hat 8 is hat(2,3), rank 35). Companion Lean module `DenseWeilCore.lean` (42 theorems; honest analytic remainder stated). No marker move, no RH claim. Machine-checked: [verification/v762_dense_weil_core.py]. [E] (exact $\mathbb{Q}$ certificates; Lean companion) + (MEASURED) (density rates)

The kernel-safe route and the q_f wall (PRIME.YOSIDAQF.01). One module from two probes (gates 9/10 + 7/12 preregistered; verdicts YOSIDA-PARTIAL/QF-DEAD). The bounded Yosida transform $Y_\varepsilon = A(A + \varepsilon I)^{-1}$ carries the handoff rates ($|b_Y - b_G| \leq 10^{-13}$; sandwich verified) with no $1/\varepsilon$ bound and no PD-margin assumption — the circularity kill did not fire; the near-kernel converges as a stable object; fixed- f ε -limits are monotone and contraction-certified. The honest negative: q_f (the battery near-kernel pairing) is non-Cauchy at honest maximal depth ($X = 15.1875$, 279849 atoms) and survives orthogonalization by structural subordination (89–99.9% of every battery function in the six-mode near-kernel span) — Gate 3 of the diagonal Gram round closes negatively: *the q_f wall* is the round's named wall object. [2026-08-05: adjudicated by the qf offensive — q_f is representation gauge and the route closes; see the five blocks below.] Controls fire. No marker move, no RH claim. Machine-checked: [verification/v763_yosida_handoff.py]. [E] (exact operator identities) + (MEASURED) (convergence profiles; honest preregistered negative)

The handoff red team (PRIME.HANDOFFREDTEAM.01). One module from two probes (16+8 checks; combined verdict REDTEAM-GREEN-COMBINED). Static firewall clean (zero blacklist hits over all 21 source-path functions; whitelist and target-field quarantine hold; source strictly before target); baseline reproduced exactly; 8/8 controls break (the forbidden separate atom/pole accounting is destroyed at $21.5 \times E^*$ — the pairing is real structure). RT6 decided: excess-mode deck corruptions break *only* the symbol gate (min symbol $-0.45..-1.72$; the six other gates measurably blind); the deficit mode is caught by rate/ratio/ κ — complementary gate families. Binding note: certificates must always carry *both* gate families. No marker move, no RH claim. Machine-checked: [verification/v765_handoff_redteam.py]. [E] (static audit) + (MEASURED) (control battery; RT6 decision)

The Gate-3 audit pair (PRIME.QFGAUGE.01). One module from two probes (5/5 gates + 34/168 cells; 14/14 + 14/14 guards+controls, ~ 18 s; verdicts QF-GAUGE/GATE3PRIME-DEAD). Gate 3's full-ladder Cauchy demand on q_f was provably *stronger* than the diagonal contract needs: a deterministic ε -net subsequence (density 0.144) makes all 14 profiles Cauchy at the parent bars, and the contract's E_Y corner objects are blind to q_f jumps (corr +0.038; the 0.34 mode-entry jump at routine corner level; median $\rho = 1.13$) — q_f is representation gauge, owning the ε -scale distribution of the deficit, not the value. But the corner-native weakened Gate 3' dies on its own predeclared 1.6×10^7 comb ($X = 16.5625$): the corner increments fall to $X \sim 12.9$ and then rise sustained (+0.10..+0.34 per X unit at $\varepsilon = 10^{-3}$, 0/56 cells) — the v764 precondition is refuted at the corner level. Controls fire. No marker move, no RH claim. Machine-checked: [verification/v769_qf_contract_necessity.py]. (MEASURED) (gauge finding; honest preregistered corner-level death)

The transport pair (PRIME.QFBUNDLE.01). One module from two probes (gates 4/5 + 4/5 with exactly the preregistered decider/Z fails; 19/19 + 14/14 guards+controls, ~ 28 s; verdicts

QF-BUNDLE-PARTIAL/QF-SETTLES-POSITIVE). The Kato/polar transport of the rank-6 near-kernel is well-defined with wide margins (rank stable, gap $6/7 = 0.34..0.56$, angles $\leq 2.72^\circ$, TV flattening) and repairs the rigid frame for 14/14 functions (median med5 ratio $26.7 \rightarrow 1.004$); the residual non-Cauchy part is the frame-independent band-weight drainage (radial share ~ 0.64) — and that drainage was a transient: on the 10^8 comb ($X = 18.375$) the band weights plateau at positive per-function constants ($R2$ 0.225–0.358, $R1$ 0.008–0.079; zero-bar depth $X^* \sim 227 = \text{never}$); the $6/7$ gap bottoms at 0.1008 and recovers; the holonomy exponent is ~ 1 (step refinement closed). The Feshbach / boundary-triple treatment becomes mandatory. Controls fire. No marker move, no RH claim. Machine-checked: [\[verification/v770_qf_spectral_bundle.py\]](#). [E] (transport Wards at machine scale) + (MEASURED) (settled levels; honest preregistered decider fail)

The representation census (PRIME.QFCENSUS.01). Gates 6/12 with exactly the preregistered fails; 26/26 guards+controls, ~ 12 s; verdict QF-REPRESENTATION-OPEN. The $6 = 1+5$ hypothesis $E_{qf} \cong E_7 \oplus E_{-2}$ fails the frozen census: the label side is sharp ($BB^T = 4I + 3J$ exact, spectrum $(1, 9, 5)$); of 64 alternating forms exactly one is σ -invariant = the canonical $\bar{h}$) and all 27 wrong forms + 5 wrong labelings die on σ -sharpness — but the deployed scalar comb realizes only two characters of V , no rank-6 lift exists, and the near-kernel is a continuum-vs-odd-places balance (ro-dominant count 0/6 vs predicted 5). Honest residue: one rung-stable ram-odd contact direction ($\cos = 0.997$) plus a second contact at $\cos \sim 0.64$; the dimension match stays typed decorative. Controls fire. No marker move, no RH claim. Machine-checked: [\[verification/v771_qf_representation_census.py\]](#). [E] (exact incidence/canonicity/character identities) + (MEASURED) (angle structure; honest preregistered OPEN)

The fixed- d pair (PRIME.QFFESHBACH.01). One module from two probes (gates 9/12 with exactly CAUCHY-6/GAP-7/GAP-8 failing + EDGE-A fail/EDGE-B pass/KM2 quiet; 28/28 + 20/20 guards+controls, ~ 180 s at full frozen ladders; verdicts FESHBACH-PARTIAL/EDGE-KEEPS-MOVING; one declared guard-normalization correction, gates identical). The $d = 6$ Feshbach reduction is exact (reconstruction 8.8×10^{-13} against independent dense solves) and matrix-Herglotz certified, but its Cauchy tail flattens where mode 7 grazes the band; $d = 7$ converges strongly ($b_2 = +0.502$) but loses separation at the top rung; $d = 8$ has an internal 8/9 crossing. On the 10^9 comb ($X = 20.6875$) the 7/8 edge closes into an avoided crossing (0.0039 at $M = 1240$, tail 0.0074 vs bar 0.10) while the transported $d = 7$ block stays Cauchy straight through; the 9th mode enters at $M = 1276$; the entry cadence widens ($\Delta X = 1.625/1.8125/2.625$, spread 0.381). Fixed- d Feshbach is closed permanently — band ownership, not convergence, is the obstruction. Controls fire. No marker move, no RH claim. Machine-checked: [\[verification/v772_qf_feshbach_effective.py\]](#). [E] (exact Feshbach reconstruction; Herglotz certificates) + (MEASURED) (moving edge; cadence)

The closure decider (PRIME.QFCOCYCLE.01). Gates 2/8 with exactly the six convergence-cell fails; 14/14 guards+controls, ~ 28 s; verdict COCYCLE-DOMAIN-ONLY; one declared implementation correction (Hotelling refinement of the carried state; algebra, gates and bars untouched). Structure without limit: the exact Möbius/Redheffer cell identity holds at 9.7×10^{-12} over 73 rungs $\times 5$ z (coefficients = the added source rows/columns; independent dense-solve Ward 1.3×10^{-13}); every cell Schur block is PD (a monotone Loewner flow); the Nevanlinna/Stieltjes domain is preserved with zero breaches through both typed mode-entry transitions ($M = 992$, $M = 1108$) — but no renormalized object converges at reachable depth (0/6 cells). Per the frozen stakes the diagonal Gram route closes (PRIME.GRAM.DIAGONAL.01 carries the dated closure note) and the sharpened PRIME.Z1.OPERATOR.01 takes over [2026-08-05: executed as the v780 trilogy — see the round-19 block below; the exact cell-cocycle core is now also machine-checked in Lean, `TfptCarrier/CellCocycle.lean`, 18 declarations]. Controls fire. No marker move on evidence lines, no RH claim. Machine-checked: [\[verification/v773_qf_cell_cocycle.py\]](#). [E] (exact cell identity; domain-preservation census) + (MEASURED) (convergence adjudication; closure per the frozen stakes)

The sharpened-Z1 trilogy (PRIME.Z1.COMPACTNESS.01). One module from three probes (gates $3/4+1/4+$ legs $3/6$ with exactly the preregistered fails; guards+controls $20/20+23/23+23/23$; ~ 270 s

at full frozen ladders; verdicts Z1-SIGNATURE-PARTIAL/Z1-TRIPLE-PARTIAL/Z1-VAREGE-PARTIAL). The N2 GNS/Jacobi family carries edge collisions at the source depth (0.0032 vs 0.0039), the ram-odd contact (cos up to 0.9971) and settled couplings (14/14 P) natively — but not the widening cadence (regular quadrature filling, free-Jacobi type); the finite boundary triple ($A = 2 - J_K$, imported Gram band) is exactly Herglotz through all typed transitions but dies as a whitened $K = M/2$ import (cell-mass exactly 0.500 beyond the half-window; delivery 5.88; still arithmetic-specific: 5.9 vs GOE 13.0 vs random 132.5); with the raw μ -weighted import the variable-edge family is bounded (0.936) and equicontinuous (0.807) with summable $\sim$ rank-one entry poles at the arithmetic thresholds (c_{mass} 0.032 $\ll$ 1; rank ratios 0.80–0.87), while delivery is typed UNRESOLVED-BY-THIS-METRIC and the moment functionals oscillate (22.1). Measured unification: PRIME.KMS.INDUCTIVE_STATE.02 and PRIME.Z1.OPERATOR.01 share their compactness theorem (carried) and share one remaining obstruction — the import-faithful boundary coupling; the merged target is named Z1-COMPACTNESS. No marker move, no RH claim, nothing beyond $X = 20.3125$. *[2026-08-06 round-23: the selection half is finite-level SOLVED — Mosco form convergence + Friedrichs minimality replace the failed moment selector on identical rungs (moment osc 22.08 vs Friedrichs resolvents 0.0004, cofinal-unique 2.5×10^{-5} ; nothing whitened at the core), [verification/v816_prime_mosco_selection.py], MOSCO-SELECTS; the historical 22.1 oscillation above stays on record as the measurement that motivated the replacement.]* Machine-checked: [verification/v780_z1_compactness_trilogy.py]. [E] (Herglotz/Ward exactness) + (MEASURED) (compactness carried; selection open — since solved finite-level, see the Mosco block below)

The packet-480 adjudication (PRIME.PACKET480.01). One probe (28/28; verdict PACKET480-ADDRESS-ONLY; the kill fired as preregistered). Header(p) = ($p \bmod 30$, $a_p \bmod 32$) is exact 7-bit address arithmetic (CRT to $p \bmod 480$; $\varphi(480) = 128 = 8 \times 16$ classes, all hit; decoder via the check32 congruence recomputed independently) — but $(\mathbb{Z}/480)^\times$ (type 2.2.4.8, exponent 8) admits no faithful canonical action on the 128 E_8 spinor roots (canonical torsor group $\mathbb{F}_2^7$, exponent 2); 3 of 7 bits realizable; maximal canonical action = the order-8 graded image $\langle \mu_4, \varepsilon_{67} \rangle$; the 128 stays a fingerprint. Controls fire; ROOTCLASS-MIXED fences every matter-adjacent reading. No marker move, no RH claim. Machine-checked: [verification/v786_prime_packet480.py]. [E] (exact address arithmetic) + [X] (preregistered kill fired)

The arrow ledger and the broadcast (HECKE.ARROW_MESSAGE.01). One module from two probes (48/48 + 21/21; verdicts ARROW-LEDGER-STRUCTURED/BROADCAST-EXACT). The 15 ramified arrows are the 15 polar labels σ -equivariantly (7 NS + 8 R); spread census (3, 1, 1, 1, 1) with the 3-block at the polar label; the two-step ledger collapses label-resolved to $T/196 = (4/49)I + (45/49)\Pi_0$ exact, $T = 4B^2$, the 105 leg classes = the v756 Kraus index set with weight $(7^{-1/2})^4$; the trace collapse is exact with $a_7 = +24$ now sign-derived (full 137600-line census); $n_B = (\sigma_3^2 - a_p^2)/8$; the entropy accounting is a typed distribution measurement (no decoded message). The broadcast: on every odd shell $n \in \{3, \dots, 13\}$ the joint census factorizes exactly as $\bar{T}_n = M_n \otimes I_{16}$ with $B_n = 16R(n)$ arrow-exactly; new identities $b = 2A_p$ and $n_B = A_p B_p/2$; honest negative: $R(p) \neq$ the type-B Weyl orbit count at $p = 7$ ($13 \neq 10$; completed in round 21 by the full no-arrow-realization adjudication, [verification/v797_r_microstate_identification.py]). All controls fire. No marker move, no RH claim. Machine-checked: [verification/v787_hecke_arrow_broadcast.py]. [E] (exact ledger/factorization identities) + [C neu] (channel reading fenced)

The positive descent (PRIME.POSITIVE_DESCENT.01). One probe (30/30 incl. the 5 must-fire controls; verdict DESCENT-PARTIAL; the declared run-1 $\rightarrow$ run-2 calibration carried verbatim). The packet GNS state on $\mathbb{N}[C_2] \otimes \mathbb{N}[\mathbb{F}_2^4] \otimes \mathbb{N}[\mu_4]$ is manifestly positive at every depth (all 128 character values ≥ 0 exactly on the Fraction leg); the naive linear pushforward is *not* a state (F1: -6.6×10^{-2} , depth-flat — signedness is observer projection); the GL1 descent is bit-identical to the deployed Weil window (rel 6×10^{-16}) and is its unique PSD sector of 24 (F2: the breaking tensor factor is the continuum/pole leg, not the registers; arch-only flat vs arch+pole falling). The three-object contract is registered open [O]: sector-adapted continua / GL1-sector PSD persistence in the Z1-COMPACTNESS frame / the carrier intertwiner. All controls fire. Round-21

follow-up (markers unchanged, the contract stays [O]): all three objects are now delivered at finite level — the continua functorially ([verification/v793_f8sector_conductor.py]), the limit object identified and the trend measured ([verification/v794_cp_extension_gate.py]), the intertwiner in Stinespring form ([verification/v801_prime_cp_intertwiner.py]); the remaining analytic core is the per-sector positivity floor. Round-23 follow-up (markers unchanged): selection and uniqueness both finite-level delivered — Mosco selection ([verification/v816_prime_mosco_selection.py]) and the master theorem ([verification/v817_positive_descent_master.py], prime state defects summable at 0.701/doubling); the floor reduces to the single ratio inequality $\rho = \tau/\tau_{\text{pnt}} > 0$ ([verification/v818_sector_floor_attack.py], PRIME.FLOOR.RATIO.01 [O]). Round-24 follow-up (markers unchanged): the floor contract is *narrowed* — the lock-block floor $\lambda\tau$ carries a certified three-piece lower-bound skeleton on the deployed battery, closed at citation grade for all h up to $\alpha^* \approx 11$ ([verification/v823_prime_lagrange_floor.py], [verification/v824_prime_floor_skeleton.py]); battery-relative, α -bounded, still open. Round-25 follow-up (markers unchanged): the kill gates survived at full sieve depth $X = 25.5$ with growing margins, the certified family replaced the collapsing single pair, and the α^* horizon fell as a float-convention artifact — citation grade to $\alpha = 12.75$, the envelope certified-explicit at $c_{\text{cert}} = 4.335$ ([verification/v829_prime_floor_depth.py], [verification/v830_prime_float_budget.py]); the alias-phase proof blocker named, still open. Round-26 follow-up (markers unchanged): the blocker resolves into a *typed pair-correlation circularity boundary* — the analytic-envelope route is closed honestly and the bridge contract PRIME.FLOOR.PAIRCORR.01 [O] registered ([verification/v831_prime_alias_second_moment.py]); still open. Round-27 follow-up (markers unchanged): both corner-era routes at that wall are decided — the corner route’s structural half closes weight-generically but is comb-blind (the wall relocates into the identification step), and the commutant SOS route closes definitively by exact certificates; both stop-listed, the bridge contract unchanged ([verification/v835_corner_hjelmlev_tower.py], [verification/v836_commutant_sos_closure.py]); still open. Round-28 follow-up (markers unchanged): the corner route’s perimeter closes as measured compression-class theorems (doors, tower levels, expectations, position carriers — the identity is an extremal state condition), the zero-side demand saturates the GUE boundary structurally with the bootstrap loop short, and the route *reopens* with the relational input: the identification carrier exists, the identified corner’s excess is positive on all 67 rungs, and the certified skeleton types the wall as the infinite quantifier over strictly-positive certified enclosures — sharpened demand: a uniform lower bound on the excess margin ([verification/v837_corner_closure_quantifier.py] – [verification/v842_excess_certified_skeleton.py]); still open. Round-29 follow-up (markers unchanged): the margin becomes a *doubly-derived typed law* — $\tau = e_1(\alpha) h^{-3/2} \tau_{\text{pnt}}(\alpha)$ with the certified envelope constant reproduced exactly across both coordinate systems ($\min e_1 \geq 4.335$ on all 67 rungs), the tower gives scale not recursion, the excess is a growing cancellation (the wall self-similar at cell level), and the finite-table limit is kernel-checked in Lean 4 ([verification/v843_margin_law_excess_lean.py], TftpCarrier/ExcessSkeleton.lean); still open. Round-30 follow-up (markers unchanged): the three candidate proof architectures are decided — the relational Schur–Gram structurally (the forced Cauchy–Schwarz price, geometry-independent), the sign-register wedge at the uniformity wall, the completed-cell cone transport at the $n = 2$ cell ([verification/v846_schur_spectral_mother.py], [verification/v847_wedge_cellcone_transport.py]) — and the continuum extraction is complete: the wall is exactly hypothesis (H), finite positivity along a ladder cofinal in the mesh-refinement order ([verification/v848_extraction_chain.py], PRIME.EXTRACTION.CHAIN.01); still open. Round-31 follow-up (markers unchanged): the invariance atlas — the nuclear-norm tax theorem closes the positive-dilation class in any basis and the index route by measurement ([verification/v850_completion_tax_flow.py]), the cone violations resolve into the graded kernel law ([verification/v851_cluster_kernel_field.py], PRIME.CELLCONE.GRADEDKERNEL.01 [O]), the wall is invariant across criteria and input classes ([verification/v855_invariance_atlas.py]), and the minimal hypothesis is kernel-checked: (H_{cof}) , with UniformMarginBound formally demoted to an over-strong sufficient lemma ([verification/v849_cfin_unique_cofinal_lean.py], TftpCarrier/CofinalWeil.lean,

FORM.PRIME.COFINAL.WEIL.01); the later `CofinalPredefinition.lean` hardening makes PREDEFINED an explicit external contract rather than a field-order claim; still open. Round-32 follow-up (markers unchanged): the grade law — the graveyard unified by the kernel-checked homogeneity no-go (`[verification/v859_grade_no_go_elevator.py]`, `TfptCarrier/GradeNoGo.lean`, FORM.PRIME.GRADE.NO_GO.01 [F]), the connected covariance evades the nuclear tax and dies on the grade gap (`[verification/v856_connected_current_lean.py]`), the finite-head phase-rescue family closed by theorem (`[verification/v860_phase_lever_closure.py]`), the elevator class closed on the deployed sides ($\tau^* = 6.27$), and the conditional frame three hypotheses $\Rightarrow (H_{\text{cof}})$ kernel-checked (`TfptCarrier/CofinalCurrent.lean`, FORM.PRIME.COFINAL_CURRENT.01 [F]); still open. No marker move, no RH claim. Machine-checked: `[verification/v791_positive_descent.py]`. (MEASURED) (exact-rational positivity; unique PSD sector) + [O] (three-object contract registered)

Sector continua and the conductor functor (PRIME.SECTOR_CONTINUA.01). One module from two probes (15/15 + 16/16; verdicts F8SECTOR-PSD/CONDUCTOR-FUNCTORIAL). The f_8 sector, broken at $-132..-151$ under the register-trivial GL1 continuum (v791 F2), is PSD on the entire frozen ladder with its *own* weight-4/conductor-8/no-pole continuum ($+1.52 \times 10^{-4} \rightarrow +3.20 \times 10^{-5}$ over $X = 4..10$); the χ_4 sector likewise; three-sector coherence; the wrong continuum reproduces the parent breakage at -140.8 . The continuum assignment is one closed structure map $\chi \mapsto q^{s/2} \prod_j \Gamma_{\mathbb{R}}(s + \mu_j)$ (duplication ward 2.7×10^{-15}); the twist $f_8 \otimes \chi_{-4}$ has conductor 16 decided inside the Atkin–Li bound by the Fricke ward (6.7×10^{-16}) and lands PSD with the rule continuum; four-sector coherence; the conductor datum is load-bearing at exactly $\ln 2$ and pinned from below by the PSD margins. Sector PSD stays finite-level evidence (GRH-type statements unproven). Round-22 follow-up: χ_8/χ_{-8} land PSD under the same rule (exact parities), so the rule map now covers the full mod-8 dual group (`[verification/v806_hecke_local_clifford.py]`). Controls fire. No marker move, no RH claim. Machine-checked: `[verification/v793_f8sector_conductor.py]`. (MEASURED) (PSD ladders under frozen gates) + [E] (rule instances, convention lock, Fricke conductor)

The CP extension gate (PRIME.CP.EXTENSION.01). One probe (17/17; verdict CPGATE-UNDECIDED-FALLING; two declared run-1 $\rightarrow$ run-2 repairs carried). The net data a CP-extension theorem consumes are measured: restriction exactness (the sector Weil functional W_χ is well-defined on the union space V_∞ without a limit), Cauchy interlacing, uniform boundedness (the frozen $e^{X/2}$ pole prediction was wrong — measured $\ln$ -slope 0.079; the whole family near-uniformly bounded). The limit object is typed exactly: per automorphic character the positivity floor $\inf_X \lambda_{\min}(T_{\chi,X}) \geq 0$ — the v780 Z1-COMPACTNESS demand sector-decorated (anchor 3.882×10^{-6} at $M = 1176$ reproduced). Deep trend: no sector crosses zero; GL1 falls power-law to 3.9×10^{-6} at $X = 18.375$ ($\beta = -1.69$), f_8 $\beta = -1.63$, twist $\beta = -2.10$, and χ_4 saturates at $\sim 1.5 \times 10^{-6}$ — the first measured sector floor. [2026-08-06 round-23: the floor demand is now reduced to the single ratio inequality $\rho = \tau/\tau_{\text{pnt}} > 0$ with a measured $h^{-3/2}$ envelope (`[verification/v818_sector_floor_attack.py]`, PRIME.FLOOR.RATIO.01 [O]); round-24: narrowed by the certified floor skeleton (`[verification/v823_prime_lagrange_floor.py]`, `[verification/v824_prime_floor_skeleton.py]`) — battery-relative, α -bounded; round-25: the kill gates survived at full sieve depth and the α -bound fell at citation grade (`[verification/v829_prime_floor_depth.py]`, `[verification/v830_prime_float_budget.py]`), the envelope certified-explicit ($c_{\text{cert}} = 4.335$); round-26: the analytic-envelope route closed at its typed pair-correlation boundary (`[verification/v831_prime_alias_second_moment.py]`, PRIME.FLOOR.PAIRCORR.01 [O]), still open; round-27: both corner-era routes at the wall decided — corner structural half closed weight-generically but comb-blind, SOS route closed by exact certificates (`[verification/v835_corner_hjelslev_tower.py]`, `[verification/v836_commutant_sos_closure.py]`), the wall relocated into the identification step, still open; round-28: the closure quantifier completed and the relation route opened — the identification carrier exists with the relational input, the excess positive on all 67 rungs, the certified skeleton strictly positive (`[verification/v841_relation_carrier_ladder.py]`, `[verification/v842_excess_certified_skeleton.py]`), the wall = the infinite quantifier over certified enclosures, still open; round-29: the margin typed as the doubly-derived law

$\tau = e_1 h^{-3/2} \tau_{\text{pnt}}$ ($\min e_1 \geq 4.335$ on all 67 rungs, both coordinate systems), the tower scale-only, the excess a growing cancellation, the finite-table limit kernel-checked in Lean (`[verification/v843_margin_low_excess_lean.py]`), still open; round-30: the three architectures decided (Schur/spectral price geometry-independent, wedge uniformity, cone broken at $n = 2$) and the extraction chain complete — the wall is exactly hypothesis (H) (`[verification/v846_schur_spectral_mother.py]`–`[verification/v848_extraction_chain.py]`), still open; round-31: the invariance atlas — the wall the same across compressions (the diverging nuclear-norm tax, basis-invariant), geometries, criteria ($BD = 2\lambda_1$) and input classes (statistics = sieve), the violations graded (PRIME.CELLCONE.GRADEDKERNEL.01 [O]), and the minimal hypothesis kernel-checked as (H_{cof}) (`[verification/v850_completion_tax_flow.py]`–`[verification/v855_invariance_atlas.py]`), still open; round-32: the grade law — the graveyard unified by one kernel-checked homogeneity no-go, the licensed rates elevator closed on the deployed sides by signed densities, the phase-rescue family closed by theorem, and the covariance instrument typed (`[verification/v856_connected_current_lean.py]`–`[verification/v860_phase_lever_closure.py]`), still open.] Controls fire (conductor swap = margin $-\ln 2$ at 2.2×10^{-16}). No marker move, no RH claim. Machine-checked: `[verification/v794_cp_extension_gate.py]`. (MEASURED) (net properties, deep trend; the persistence demand stays the open core)

The carrier intertwiner (PRIME.CP.INTERWINER.01). One probe (29/29; verdict CP-INTERWINER-EXISTS). Demand (3) of PRIME.POSITIVE_DESCENT.01 at finite level: $\Phi(a) = V^* \pi(a) V$ with V the 105-leg Kraus stack (unitality $\sum_e E_{x_e x_e} = 7I$ exact integer) and π the arrow representation; the arrow $*$ -algebra is the full M_{15} (exact matrix-unit closure; involution = arrow reversal); the Choi matrix is exact-rational (105 eigenvalues each $1/7$; PSD structural); all covariances exact (σ , deck $T = 4B^2$, half-weight, $\beta = 1$ balance). The four automorphic character channels of the one map land on the four sector windows: GL1 = the deployed Weil window at rel 6.0×10^{-16} ; χ_4/f_8 /twist on their $\Gamma_{\mathbb{R}}$ -rule objects ($\sim 10^{-15}$), all PSD; the ramified conductor emptiness is structural; the v791 F1 failure is retyped as a negative Choi eigenvalue. The infinite-level demands D1–D3 (dilation family; normality on the Z1-COMPACTNESS object; the limit identification with the critical-line Weil functional — contains RH) stay open and fenced. Controls fire. No marker move, no RH claim. Machine-checked: `[verification/v801_prime_cp_intertwiner.py]`. [E] (Stinespring/Choi exact) + (MEASURED) (channel landings) + [O] (D1–D3)

The Gray register chart (PRIME.CARRIER.GRAY.01). One probe (23/23; verdict GRAY-INTERWINER-EXISTS; one declared run-1 $\rightarrow$ run-2 control repair carried verbatim). The affine Gray map encodes $C_2 \times \mu_4$ into the R-class torsor exactly respecting the v786 Packet480 kill (a group isomorphism is impossible — exponent 4 vs 2 — and not demanded); the fiber family is deck-covariant exactly with *trivial* measured μ_4 -cocycle, the residual being a pure $\mathbb{Z}_3$ line twist on the σ -fixed classes; the extended Stinespring map's GL1 channel re-lands on the deployed Weil window at rel 6.0×10^{-16} . The v801 intertwiner thereby gains its register chart at the odd places. Controls fire. No marker move, no RH claim. Machine-checked: `[verification/v804_prime_carrier_gray.py]`. [E] (exact covariance, trivial cocycle) + [O] (D1–D3 typed)

The Kraus context protocol (PRIME.KRAUS.DOILY.01). One probe (21/21 incl. the 3 must-fire controls; verdict KRAUS-DOILY-PROTOCOL; one declared run-1 $\rightarrow$ run-2 report-text repair carried verbatim). The 105 Kraus legs of the v801 intertwiner are a complete context protocol over the doily $W(3, 2)$: 15 diagonal + 90 off-diagonal; the canonical 45 + 60 split is the reversal quotient (the 90 legs double-cover the 45 flags 2:1) plus fiber expansion ($15 \times 4 = 60 =$ the v783 stabilizer rays); the $Sp(4, 2)$ obstruction certifies that *no* leg-subset partition exists — the literal partition is spread-relative = the ledger T3 census; the 45 transports are quadratic ($P_x P_y = \pm P_{x+y}$) spanning $\text{End}(\mathbb{C}^4)$ at rank 16. The surprise: $[B_{45}, B_{60}] = 0$ exactly — $K = \frac{3}{7}E + \frac{4}{7}R$ is a direct-sum protocol with E a conditional expectation. Measured: the certified spread is *not* σ -invariant — the named next falsifier [decided in round 23: σ has zero fixed spreads (outer-class forced) but the protocol is σ -stable as a family, and $[E, K] = 0$ extends to the full tower — `[verification/v815_kraus_spread_commutant.py]`,

see the commutant-tower block below]. Controls fire. No marker move, no RH claim. Machine-checked: [verification/v811_prime_kraus_doily.py]. [E] (protocol identities; exact commutant) + (MEASURED) (spread non-invariance)

The Kraus commutant tower (PRIME.AORB.REFINEMENT.01). Two probes (21/21 + 24/24; verdicts SPREAD-SIGMA-BROKEN + COMMUTANT-EXTENDS + AORB-NOT-MAXIMAL; one declared gate-implementation repair carried verbatim). σ acts on the six spreads as two 3-cycles, zero fixed (outer-class forced); no invariant coarsening survives, but the direct-sum protocol is σ -stable as a family ($\sum_s B_{45}(s) = 4I + 2B$; per-orbit A_{orb} spectrum $\{0^5, 1^2, 4^5, 7^2, 9^1\}$); $[E, K] = 0$ lifts exactly to channel/KMS-tower/odd places (the unique C_2 -character expectation per place) and the 600-dim register; the $\{K, \sigma\}$ commutant is 39-dim nonabelian with A_{orb} its canonical abelian 5-dim subalgebra — window-silent beyond the K -spectrum. Controls fire. No marker move, no RH claim. Machine-checked: [verification/v815_kraus_spread_commutant.py]. [E] (censuses; integer-exact commutation) + (MEASURED) (protocol-internal windows)

Mosco selection (PRIME.MOSCO.SELECTION.01). One probe (23/23 guards+controls, 6/6 legs; verdict MOSCO-SELECTS). The selection problem of the unified compactness contract is finite-level solved: on identical rungs the moment selector oscillates at 22.08 while Friedrichs resolvents (0.0004), ledger-adjusted Weyl tracks (0.0843) and raw-coupling μ -face resolvents (0.0000) are Cauchy; cofinal-unique to 2.5×10^{-5} ; recovery exact (1.2×10^{-12}); the import diagnosis completed at form level (nothing whitened at the core; the whitened control reproduces 5.8772 exactly). The three infinite-level ingredients typed; positivity untouched. Controls fire. No marker move, no RH claim. Machine-checked: [verification/v816_prime_mosco_selection.py]. (MEASURED) (the finite-level decider) + [O] (the three typed infinite-level ingredients)

The sector-floor mechanism (SECTOR.FLOORATTACK.01). Two probes (9/13+13/15 with exactly the preregistered FAILs; verdicts FLOOR-MECHANISM-PARTIAL + CAPTURE-BOUNDED / THEOREM-SHAPE / AMPLIFIER-MECHANISM). The margin factorizes symbolically (onem = $F(r) \varepsilon K$, sign in the vanishing weight); the 2-mode lock block is an $O(1)$ -faithful witness of the full floor (capture median 1.53); the capture angle is scramble-robust frame geometry ($\cos \theta$ 0.990); the rotation law closes symbolically (100% staircase sign-match); the amplifier envelope $\rho h^{3/2} \in [4.85, 24.2]$ is non-decaying. The floor reduces to one ratio inequality $\rho = \tau / \tau_{\text{pnt}} > 0$ — registered as PRIME.FLOOR.RATIO.01 [O] with named kill criteria; no positivity theorem; promotion fenced. Round-24 follow-up: the contract is *narrowed* by the certified floor skeleton (the two blocks below); still [O]. No marker move, no RH claim. Machine-checked: [verification/v818_sector_floor_attack.py]. [E] (factorization; interlacing; rotation law) + [O] (the ratio inequality)

The floor as an exact sum of squares (PRIME.FLOOR.LAGRANGE.01). One module from two probes (7/8 with the one preregistered-honest old-budget FAIL + 9/9; verdicts LAGRANGE-CONCENTRATED + PAIR-CERTIFIED). Every per-zero layer of the v692 master identity is exactly rank-one ($v_\gamma = 2\sqrt{w(\gamma)}(S_1, S_2)$, closed trigonometric reads; layer deviation $\leq 1.2 \times 10^{-16}$), and $\det(G_Z + P) = \sum_{\text{pairs}} (a_i b_j - a_j b_i)^2$ holds at machine precision on all 14 rungs (ward $\leq 1.4 \times 10^{-9}$) — the floor $\det \hat{A}_2 = \lambda \tau$ is an exact sum of squares over zero+pole rank-one carriers; the pole is the universal non-collinear leg and the moving zero leg sits on the alias comb. The psd-remainder route change ($\lambda_{\min}(\hat{A}_2 - G_Z - P) \geq \text{margin per rung}$) tightens the budget a median 9.8 orders and certifies the fixed pair (pole $\times \gamma_1$) strictly positive on 14/14 rungs, share growing $h^{+1.06}$. The atom-side rank-one framing fails as frozen (typed). Controls fire (scramble, Epstein at det scale, collinear family). No marker move, no RH claim. Machine-checked: [verification/v823_prime_lagrange_floor.py]. [E] (rank-one layers; the Lagrange identity, wards) + (MEASURED) (per-rung certified intervals, shares)

The floor-theorem skeleton (PRIME.FLOOR.SKELETON.01). One module from two probes (12/12 + 9/9; verdicts FLOOR-PARTIAL + TAIL-CLOSED-ALL-H). The three-piece uniform certified lower-bound skeleton of the floor on the deployed battery: the analytic fixed-pair limit $X_\infty(\alpha) = 16\alpha\pi^2 \sin(\alpha\gamma_1) \sinh(\alpha/2)$ [bracket] with explicit $h_0(\alpha) \leq 500$ (h -uniform per deployed α ; 25 α -nodes typed); the certified top-100 family exhaustion (median 0.952 of the floor, carriers on-line $\leq 2 \times 10^4$;

the analytic family limit positive across all nodes); and the deep tail closed at citation grade for all h at the fixed verified horizon $T_{\text{ver}} = 3 \times 10^{12}$ (product-sup envelope + Abel/RvM explicit constants; margins 10^3 – 10^6 ; growth law h -free, $+1.98 \rightarrow +0.13$; validity horizon $\alpha^* \approx 11.2$). Net: $\lambda\tau \geq X^2(\text{pole}, \gamma_1) - \text{pert}(h) > 0$ at citation grade — no per-rung eigencheck, no zero-location input beyond the strip. Battery-relative, α -bounded, necessary-side; PRIME.FLOOR.RATIO.01 narrowed, not closed. Controls fire (off-line pairs break the psd chain at the off-line locus; regression ward reproduces the old closure boundary). No marker move, no RH claim. Machine-checked: [verification/v824_prime_floor_skeleton.py]. [E] (closed forms, wards) + (MEASURED) (closure margins, exhaustion) + [O] (the ratio contract, narrowed)

The certified exclusion ladder (PRIME.EXCLUSION.LADDER.01). One module from two probes (26/26 + 21/21; verdicts LADDER-EXTENDED + SATURATION-TYPED). Each verified PSD rung of the GL1 tower carries a rigorous $\lambda_{\min} > 0$ certificate (Cholesky/Higham backward-error bound + Rayleigh-residual enclosure) and is inverted into quadruple-exclusion regions on the frozen rank-4 battery, every boundary point witness-Rayleigh re-proved; the ladder reaches $X = 24.81$ and the census threshold Ξ_{eff} falls $0.639 \rightarrow 0.218$, then plateaus at $0.218 \pm 3\%$ (support-active-but- X -stalled, typed). The region lies inside the Platt–Trudgian strip: consistency re-derivation, not new territory; depth-to-width bridge, not a record claim. Controls fire. No marker move, no RH claim. Machine-checked: [verification/v825_prime_exclusion_ladder.py]. [E] (certificates, wards) + (MEASURED) (exclusion maps, the Ξ census)

Battery v2 and the range extension (PRIME.EXCLUSION.BATTERY2.01). One module from two probes (16/16 + 13/13; verdicts FLOOR-LOWERED + RANGE-DECIDES-DECLINE). The pre-registered battery v2 (SHA-256 fd39fb42.. hashed before any evaluation; no zero datum in the design) cuts the exclusion floor $0.2187 \rightarrow$ the uncensored declining series $0.1066 \rightarrow 0.0816$ (slope -1.39): the v825 plateau was instrument-relative; benchmark $\delta \geq 10^{-3}$ at $X^* \approx 81.6$ (extrapolation, typed); the -0.872 zero-distance rank correlation typed as the hash-verified non-circular side-finding. Controls fire. No marker move, no RH claim. Machine-checked: [verification/v826_prime_exclusion_battery2.py]. [E] (hash wards, subset ward) + (MEASURED) (the uncensored series, the decline)

The zero locator (PRIME.EXCLUSION.LOCATOR.01). One module from two probes (the one preregistered-honest C3 FAIL + 13/13; verdicts LOCATOR-NUL + LOCATOR-V2-RESOLVES). The width profile of the certified tower peaks at true zeta ordinates (explicit-formula redundancy); the v1 rule honestly failed its frozen gates (61% false peaks) — on record — and the preregistered v2 rule (prominence $\geq \ln 2.2$, hash f57a2e7f..) passes out-of-sample on the disjoint window [60, 120]: $20/24 = 83\%$ detection, 0% false positives, precision 0.086, all four controls; depth law $54 \rightarrow 62 \rightarrow 83\%$. Location to ± 0.25 is strictly weaker than classical verification. No marker move, no RH claim. Machine-checked: [verification/v827_prime_zero_locator.py]. [E] (preregistration hashes) + (MEASURED) (out-of-sample scores)

The comb-native window verification (PRIME.EXCLUSION.WINDOW.01). One probe (12/12; verdict COMB-VERIFIES-WINDOW; contract PRIME.DETECTOR.WINDOW.01 [O]). On $\gamma \in (60, 120]$ at $X = 24.8125$ the same certified positivity object yields location (21/25 ordinates to ± 0.25 , zero unmatched peaks), exclusion ($\delta \geq \delta_{\text{mb}}(\gamma)$, uniform 0.0496, witness-certified) and the census (21 + 4 typed misses = 25 = cache = rounded RvM main term); new deepest certified rung $X = 25.5$ (cap 1.2×10^{11}). Mandatory typing: strictly weaker than classical (Turing) verification on every axis — a necessary-side consistency demonstration; does not bear on RH. Controls fire (the scramble fails all three axes). No marker move. Machine-checked: [verification/v828_prime_comb_window.py]. [E] (census arithmetic, certificates) + (MEASURED) (location/exclusion legs) + [O] (the detector contract)

The depth kill survived (PRIME.FLOOR.DEPTHKILL.01). One module from two probes (16/17 with the one preregistered-honest S5.HLAW FAIL + 12/12; verdicts ENVELOPE-HOLDS-DEEP + FAMILY-SCALES). The PRIME.FLOOR.RATIO.01 kill gates (envelope $c = 4.85$ no refit; capture

$\cos^2 \theta \geq 1/2$) played at $X = 18.375\text{--}25.5$ and survived with margins $\times 5.76\text{--}\times 8.92$ growing (the deep frames decouple depth from dimension — the h -law wins); the single pair collapses (gap $40\times \rightarrow 673\times$, typed) while the certified family carries $0.977\text{--}0.981$ of the floor (ρ_{certfam} within 2% of measured); α -coverage typed (citation grade to $\alpha^* \sim 11$ only — the v830 blocker). Controls fire. [O] stays. No marker move, no RH claim. Machine-checked: [verification/v829_prime_floor_depth.py]. [E] (identity wards, mpmath anchors) + (MEASURED) (margins, shares, gaps)

The linear budget and the explicit envelope (PRIME.FLOOR.BUDGET.01). One module from two probes ($10/10 + 19$ checks with the five preregistered-honest asymptotic FAILs; verdicts BUDGET-LINEAR-CLOSES-ALL + ENVELOPE-ASYMPTOTIC-PARTIAL). The Higham-linear float budget ($7\times\text{--}171\times$ tighter, explicit constants, dps-40 anchors) closes the citation-grade family gate 6/6 at full sieve depth — $\alpha^* \approx 11$ was a float-convention artifact, citation grade extends to $\alpha = 12.75$; the deployed v818 convention stays frozen, the linear budget is convention for new modules only. The family closed form is exact on 73/73 frames (3.6×10^{-11}), the limit algebra sympy-proven, phases cannot conspire (0.170), and the envelope is certified-explicit ($\rho \geq 4.335 h^{-3/2}$ on 73/73); the proof blocker named: alias phase correlations (random-phase h^{-1} vs the $h^{-2.5}$ tower). Controls fire. No marker move, no RH claim. Machine-checked: [verification/v830_prime_float_budget.py]. [E] (sympy algebra, closed forms, budget wards) + (MEASURED) (closures, the envelope constant)

The typed circularity boundary and the pair-correlation bridge (PRIME.FLOOR.ALIASMOMENT.01). One probe (15 checks with the seven preregistered-honest premise-overturning FAILs, pattern-gated; verdict ALIAS-CORRELATION-PAIRCORR; verbatim promotion, no downscoping). The correlation-corrected alias second moment is exact (sympy-proven bilinear form: $\tau = (S_2 - S_c)/2 - S_c^2/(4P_0) + O(P_0^{-2})$, rotation ward on all 73 frames); the round-25 premise “the phases carry the gap” is *overturned* — the amplitudes carry it, decomposing the tower exactly as $-2.505 = -3.172$ (amplitude law) $+0.668$ (fading alignment), with $q = S_c/S_2$ sign-changing and the deep suppression only $\times 1.1$; the exact Guinand split puts the coherent sum in the prime-comb fluctuation at $0.01\times$ the Poisson square-root scale (shares $-994/+995$, cancelling; the comb scramble explodes it $10^6\times$ — the cancellation is the arithmetic). The typed circularity boundary: the required control is pair-correlation-equivalent substance, and by Guinand the comb’s self-cancellation *is* the zero-side floor statement — the analytic-envelope route is closed honestly (stop-list entry); the bridge contract PRIME.FLOOR.PAIRCORR.01 [O] is registered. Controls: comb-side fingerprints fire comb-specifically; C1/C2 restate the overturned premise (typed FAILs). No marker move, no RH claim. Machine-checked: [verification/v831_prime_alias_second_moment.py]. [E] (the sympy bilinear form, the exact split) + (MEASURED) (the overturned premise, the sqrt-scale cancellation) + [O] (the bridge contract)

The corner identity and the Hjelmslev tower (PRIME.CORNER.CHARACTER.01 / PRIME.HJELMSLEV.CPTOWER.01). One module from two probes ($21/21 + 20/20$; verdicts CORNER-IDENTITY-SYMBOLIC + HJELMSLEV-STRUCTURE-ONLY, ~ 11 s). The corner identity holds as polynomial algebra in free event weights ($\hat{c}_j = -1$ exactly for all 136 events; one arithmetic input: the glue identity $\sum \Theta_m = 240\sigma_3$); the chain-ring ladder $\mathbb{Z}[i]/(1+i)^m$, $m = 1..5$, carries a strictly projective CP tower (certified cb defect identically zero) with the identity level-exact — but identity and state corner are comb-blind (scramble control; the lock data moves $\tau = +5.98 \times 10^{-4} \rightarrow -3.51$) and the level- m corner motion is the pure register-dilution law 16^{1-m} (ratio 0.0625 exactly): the arithmetic wall relocates into the identification step and stays PRIME.FLOOR.PAIRCORR.01; register-side dressings provably cannot carry it (POSITION-KRAUS-TRADEOFF, 13/13, probe-level). Controls fire; AST firewall; no signed-prime-sum estimation. No marker move, no RH claim. Machine-checked: [verification/v835_corner_hjelmslev_tower.py]. [E] (exact group-algebra/chain-ring wards, symbolic identity) + (MEASURED) (window legs, the honest scope) + [O] (the identification wall)

The commutant SOS closure (PRIME.COMMUTANT.SOS.01). One probe (29/29; verdict COMMUTANT-SOS-INFEASIBLE, ~ 2 s; the declared SPEC v1 $\rightarrow$ v2 witness-triple repair documented). The degree-2 SOS ansatz over the canonical five-dimensional abelian subalgebra of the 39-dim

commutant is closed definitively: (a) the exact reduction lemma collapses the SDP to a rational LP whose unique feasible point is the trivial diagonal rewriting (Vandermonde kernel $\{0\}$) — no cross-sector positive transfer; (b) the rank-3 det form has signature $(1, 2)$, coefficient matching forces $G = \text{diag}(1, -1, -1)$ (not PSD) with the rational dual certificate $q(0, 1, 0) = -1 < 0$, and q -negative directions are achievable even on the nonneg cone (832/2799 truncation cuts). FENCE-CLEAN on the algebra layer, FENCE-HIT on the positivity branch — the nontrivial version is pair-correlation substance. Controls fire (comb-specific identification; the v815 sector pattern; wrong-ratio inconsistency). Route closed, stop-list entry. No marker move, no RH claim. Machine-checked: `[verification/v836_commutant_sos_closure.py]`. **[E]** (exact rational LP/dual certificates, reduction lemma) + (MEASURED) (achievability legs, typed)

The corner-closure quantifier (PRIME.CORNER.OPENDOORS.01 / PRIME.CORNER.LEVEL2.01). One module from two probes plus the Lean mirror (19/19 + 17/17 + 3; verdicts DOORS-CLOSED + LEVEL2-CLOSED, ~ 8 s). Door 1: the GL1 corner reads the full lock-pair compression — not a trace — and every visible factor dressing breaks the deployed-form identity by exactly its action on the lock pair (visibility $\Leftrightarrow$ identity defect on all 24 sweep draws; the commutant invisible at 2.7×10^{-14}). Door 2: all 128 characters collapse exactly to 18 classes and read one position-blind carrier mode per event (the generalized mass ward); the 90-cell class map has no identity $\wedge$ visibility $\wedge$ placement cell. The quantifier extends level-exactly to $m \leq 3$ (identity characters exactly $\text{Ann}(\langle S_m \rangle)$; Vfac spectra $\{1, 0, -1/7\}$ — the jet refines position-blind data only). The structural half is kernel-checked (TfptCarrier/SectorPositiveDescent.lean, no sorry: corner CP + trace split, descent transport, PSD limits, and sector_floor with IdentificationPositivity the single named hypothesis). Stop-list entries; the wall stays PRIME.FLOOR.PAIRCORR.01. No marker move, no RH claim. Machine-checked: `[verification/v837_corner_closure_quantifier.py]`. **[E]** (exact Fractions Fourier, ring duals, class maps) + (MEASURED) (window legs) + **[O]** (the wall)

The compression toolkit and the extremal pinning (PRIME.CORNER.EXPECTATION.01 / PRIME.CARRIER.POSITION.01). One module from two probes (13/13 + 13/13; verdicts EXPECTATION-CLOSED + POSITION-CARRIER-TRADEOFF, ~ 5 s). All 5276 subgroup conditional expectations (74 259 components) obey the rank-1 dichotomy (exactly two identity-retaining subgroups = the predicted pinning criterion; 0 violations); the full pinching's only PSD summands are the two pinned sectors (the joint-use kill); Stinespring-side compressions pay the identity defect coefficient for coefficient. Position-dependent carriers: all four frozen state-preserving designs fail the decisive self-consistent-comb null — the identity is an *extremal* state condition ($\hat{c}_{\text{GL1}} = -1$ locks the entire C_2 mass), so identity-true carriers read zero on every self-consistent comb, true or fake (the fourth wall coordinate, named EXTREMAL PINNING). Stop-list entries. No marker move, no RH claim. Machine-checked: `[verification/v838_corner_expectation_position.py]`. **[E]** (exhaustive lattice census, exact pinching) + (MEASURED) (window legs, the null) + **[O]** (the wall)

The pair-correlation bridge map and the GUE saturation (PRIME.FLOOR.BRIDGEMAP.01 / PRIME.FLOOR.GUESAT.01). One module from two probes (9/9 + 7/7; verdicts BRIDGE-FULLY-BEYOND + GUE-SATURATING, ~ 0.8 min per part; scholarship correction throughout: Montgomery's $F(\alpha)$ is RH-conditional, every supply row tagged). The demand in Montgomery $F(\alpha)$ -form on all 73 frames: unconditional supply misses by $52\times$ at best; the conditional window covers 43–86%; full-GUE rms closes 39/73 — the named minimal missing input: unconditional $F(\alpha, T) \leq C_F$ (0.33–1.7) out to $\alpha \approx 3$. The demand/GUE ratio saturates at $R_\infty = 1.11$ inside the frozen band ($\text{rms}(z) = 0.72$; tight band unfolded $\alpha \in 1..2$); the inverted margins give the calibrated form-factor measurement $\hat{F}(\text{win}) = 0.44 \pm 0.14$ (Poisson control calibrates; scramble fires). Necessary-side consistency only. No marker move, no RH claim. Machine-checked: `[verification/v839_paircorr_bridge_saturation.py]`. (MEASURED) (demand/supply ledgers, the instrument) + **[O]** (the named object)

The ablation and the loop gain (PRIME.FLOOR.GUEABLATION.01 / PRIME.FLOOR.LOOPGAIN.01). One module from two probes (10/10 + 8/8; verdicts SATURATION-STRUCTURAL + LOOP-SHORT, ~ 1.5 min). Every source-native, Guinand-admissible tower variant lands at the deployed plateau (1.058–1.199 vs 1.154; 0 broke positivity), with the tight band pinned at *unfolded* $\alpha \in 1..2$

under every lattice — the saturation is a property of the tower class and the unfolded zeros, not the grid (the thinned comb breaks positivity, the scramble explodes, the Epstein comb is positive-trivial). The loop gain $g = 1/(k^2 R^2 c_{\text{sup}})$: headline $g(k=1) = 0.529$; even the ideal supply gives $1/R^2 = 0.655 < 1$; $N_{\text{max}} = 0$ induction steps; the Poisson circularity ward passes — the wall’s self-conservation *is* the saturation; the measured positivity is finer-than-statistical information, unprovable by the loop. No marker move, no RH claim. Machine-checked: [\[verification/v840_gue_ablation_loopgain.py\]](#). (MEASURED) (ablation battery, loop curves, wards) + [\[O\]](#) (the wall)

The relation carrier and the nonnegative excess ladder (PRIME.RELATION.MULT.01 / PRIME.RELATION.LADDER.01). One module from two probes (18/18 + 13/13; verdicts RELATION-CARRIER-EXISTS + EXCESS-NONNEGATIVE, ~ 6 s). The corner route reopens with the relational input: $\Lambda = \mu * \log$ as exact structure; the four-comb discriminator exact (true 0; the $h = 2$ Epstein $x^2 + 5y^2$ separates at 200.0 on the class-group obstruction sites; Selberg-class-correct blindness between genuine L -functions); all four gates pass, including the self-consistency null that killed every compression and every single-event carrier (excess -0.297 vs 0 at truth). The amplitude wiring fixes L -safety automatically; on all 67 reachable rungs the identified corner’s excess over its comb-blind structural skeleton is positive ($+2.29$ to $+3.70$) — the sharpest wall form $\tau_X = \lambda_{\min}(\text{structural}) + \text{EXCESS}$. Registered [\[O\]](#); the positivity along the ladder remains unproven. No marker move, no RH claim. Machine-checked: [\[verification/v841_relation_carrier_ladder.py\]](#). [\[E\]](#) (exact relational algebra, discriminator, wards) + (MEASURED) (the excess series) + [\[O\]](#) (the registration)

The certified skeleton (PRIME.RELATION.SKELETON.01). One probe (9/9; verdict SKELETON-CERTIFIED, ~ 5 s). Strictly positive certified interval enclosures of τ_X on all 67/67 reachable rungs (widths 5.4×10^{-11} – 6.6×10^{-9} , three to five orders below the margin); the $h = 2$ fake certified-negative on every anchor (exact rational Λ_F routing); the scaling law typed (width slope $+0.62$ vs margin slope -0.52 per α ; horizon $\alpha^* \approx 9.1$, far beyond the ladder end — certifiability not binding). What remains is exactly the wall: the infinite quantifier over strictly-positive certified enclosures; the sharpened demand: a *uniform* lower bound on the excess margin. Registered [\[O\]](#). No marker move, no RH claim. Machine-checked: [\[verification/v842_excess_certified_skeleton.py\]](#). [\[E\]](#) (certified-interval enclosures above the deployed float data) + [\[O\]](#) (the infinite quantifier)

The margin law and the kernel-checked wall (PRIME.MARGIN.LAW.01 + FORM.PRIME.EXCESS.SKELETON.01). One probe plus the Lean mirror (10 checks with the *one* preregistered-honest S2.2 FAIL, kept and pattern-gated — pairwise h -exponent median -1.341 vs the frozen bar edge -1.35 , not refit — verdict MARGIN-RECURSES-THE-WALL; +4 mirror checks, ~ 6 s). The margin is a doubly-derived typed law: $\tau = e_1(\alpha) h^{-3/2} \tau_{\text{pnt}}(\alpha)$ with the certified envelope constant reproduced *exactly* in the identified-corner coordinates ($e_1 \in [4.855, 24.209]$ on all 67 rungs, $\min \geq 4.335$; τ vs $\lambda_{\min}(A_h)$ at 2.1×10^{-12}) — two independently derived laws, one object; the tower gives scale, not recursion (defect series non-decaying); the excess is a *growing* cancellation (CI median 15.6, rising $5.65 \rightarrow 29.46$ — the wall self-similar at cell level; no per-prime positive control); the compiler connection is null (0/96, Bonferroni-honest). The Lean mirror (TfptCarrier/ExcessSkeleton.lean, lake build green, no *sorry*) kernel-checks the two-giants decomposition, the interval-certificate and certified-negative discriminator lemmas, the finite-ladder quantifier, the bridge theorem `excess_floor` with `UniformMarginBound` the single named hypothesis, and the gap `pointwise_pos_not_uniform` — no finite certificate table discharges the uniform bound. No marker move, no RH claim. Machine-checked: [\[verification/v843_margin_law_excess_lean.py\]](#). (MEASURED) (the law, the cells, the null) + [\[E\]](#) (the envelope ward; the kernel-checked mirror statements) + [\[O\]](#) (the uniform bound)

The Schur program closure (PRIME.SCHUR.GRAM.01 + PRIME.SPECTRAL.MOTHER.01). One module from two probes (19 + 16 checks, zero fails, verdicts SCHUR-INDEFINITE and SPECTRAL-TV-UNIVERSAL, ~ 1 s). The manifestly positive relational Gram exists — manifest positivity, exact $\mu \log$ descent routing with the $h = 2$ Epstein refusal at construction grade, Selberg safety all green — but the corner identity fails in trace *and* form by exactly the forced Cauchy–Schwarz diagonal price

(price/ $\tau \sim 3.1 \times 10^4$ – 4.5×10^4 at the density-anchored floor; the untouched-projection deviation *is* the price). The typed missing input was then built: the unitary spectral mother ($J^2 = I$, the deployed form the J -odd Toeplitz compression at relative deviation 0, the Euler product the exact operator algebra $U_d U_m = U_{dm}$) gains 20–33× at symbol grade but never at Gram grade — the TV price is geometry-independent (the modulus bound); harvesting interference is Fejér–Riesz of the total symbol = the positivity itself. No marker move, no RH claim. Machine-checked: [verification/v846_schur_spectral_mother.py]. (MEASURED) (the price, the gains) + [E] (the exact routing wards; the operator-algebra identities) + [O] (the wall unchanged)

The wedge and the cell cone (PRIME.WEDGE.LAGRANGE.01 + PRIME.CELLCONE.TRANSPORT.01). One module from two probes (13 + 9 checks with the *two* frozen-honest FAILS kept and pattern-gated, not refit; verdicts WEDGE-PARTIAL and CONE-BROKEN + RAY-EDGE-CONFIRMED, ~ 6 s). The sign-register lift works as exact algebra — nonnegative wedge weights exist on every anchor (LP residual $\leq 8.9 \times 10^{-16}$) where the naive signed Lagrange provably cannot (forced weights, symbolic) — but the frame-uniform law fails at $\sim 15\%$ against the 4.4×10^{-5} floor need: the commutant uniformity wall transported (the scramble miss $\times 7.5$ vs $\times 10$, typed). The completed cells telescope exactly (3.4×10^{-15} ; $\Phi^T J \Phi = cJ$ at 2.2×10^{-16}), yet both groupings exit the Lorentz cone on 67/67 rungs at the $n = 2$ cell (endpoint back in-cone = the certified $\tau > 0$); the ray cascade to (5, −3, 4) is confirmed (Kendall ± 1.000); the inverted Epstein signature is kept as its frozen FAIL: the fake stays in-cone — the arithmetic sits *in* the violations. No marker move, no RH claim. Machine-checked: [verification/v847_wedge_cellcone_transport.py]. (MEASURED) (the law failure, the cone census, the ray cascade) + [E] (the exact no-go lemma; the telescoping and congruence wards) + [O] (the wall unchanged)

The continuum extraction chain (PRIME.EXTRACTION.CHAIN.01). One probe (19/19, verdict EXTRACTION-CHAIN-COMPLETE, ~ 1 s; hypothesis (H) never evaluated). The (D, X) -tower extraction with measured rates: the pure-box class carries the *exact* Weil value at every finite level (maximal error 5.3×10^{-14}); identification $\sim 4^{-j}$ (median −1.818); geometric ledger (0.302); the X -direction exactly stable (44 cutoff pairs at float zero); both controls fire (stall ratio 1.6×10^6 ; ledger inflation 5.5×10^5). The implication chain *cofinal finite positivity* (cofinal in the mesh-refinement order) $\Rightarrow$ *Weil positivity* $\Rightarrow$ (via Weil’s criterion) *the target* is theorem-grade modulo named citations, with the quantifier reduction: no Mosco compactness, no uniform δ , no diagonal argument — per-element convergence is the only analytic input. The wall is exactly hypothesis (H), and nothing else. No marker move, no RH claim. Machine-checked: [verification/v848_extraction_chain.py]. (MEASURED) (rates, ledger, exact box class) + [E] (the exact- $\mathbb{Q}$ machinery wards) + [O] (hypothesis (H) — the registered contract)

The uniqueness of C_{fin} and the minimal H theorem (CFIN.UNIQUE.01 + FORM.PRIME.COFINAL.WEIL.01). One module from one probe plus the Lean mirror (22/22, verdict CFIN-UNIQUE; +4 mirror checks, ~ 7 s; exact finite algebra, no floats). Every admissible compiler tuple at $\omega = \hbar$ is isomorphic to C_{fin} : census 14400, *one* $Sp(4, 2) \times S_5$ orbit (orbit–stabilizer $14400 \times 6 = 86400$ exact); $\text{Aut}(C_{\text{fin}}) \cong C_6$ (faithful into $Sp(4, 2)$, slot permutation determined); the strict terminal-object reading fails honestly (unique up to *non*-unique isomorphism); controls fire (dot form, wrong Arf class, no- σ canonicity death $16 \rightarrow 8 \rightarrow 4 \neq 1$). And the minimal H theorem is kernel-checked (TfptCarrier/CofinalWeil.lean, 11 declarations, 3415 jobs, axioms clean): the $\varepsilon/2$ implication and the no-diagonal dense-family form proven; the hierarchy uniform $\subsetneq$ pointwise $\subsetneq$ cofinal strict both ways (witnesses $1/(m+1)$, ± 1 on the even ladder) — UniformMarginBound formally demoted to an over-strong sufficient lemma; the load-bearing chain consumes exactly (H_{cof}) — PSD along a ladder cofinal in the mesh-refinement order in which the form convergence holds — which stays a hypothesis everywhere. The noninterference follow-up (TfptCarrier/CofinalPredefinition.lean) kernel-checks the explicit-fixed-idx API and a sign-mined old-API counterexample, and requires a named Predefined(A, idx) certificate in the hardened wrapper. Its concrete source/provenance interpretation remains external; quantifier order alone does not enforce it. No marker move, no RH claim. Machine-checked: [verification/v849_cfin_unique_cofinal_lean.py]. [E] (the uniqueness

census and its exact controls; the kernel-checked mirror statements) + [O] ((H_{cof}) — the named hypothesis)

The completion tax and the flow decision (PRIME.PSD.COMPLETION.TAX.01). One module from two probes (15 + 11 checks, zero fails, verdicts TAX-GAP and FLOW-CROSSINGS, ~ 35 s). Every positive 2-sector dilation through the fixed comb coupling pays $\text{tr } P + \text{tr } Q \geq 2\|R_X\|_*$ with equality at the SVD pair — zero-duality-gap certificates on every anchor ($\|W\|_{\text{op}} = 1.000000000000$; symbolic 2×2 gap 2.7×10^{-51}), basis-invariant ($\leq 1.1 \times 10^{-15}$; the v846 geometry-independence now a corollary) — and the tax diverges: $\geq 4057.6 \times \tau$ on all 67 rungs, growing $\sim h^{0.24}$ against $h^{-3/2}$; the measured Schur prices were only 13.7–20.4 $\times$ above the exact optimum — optimality could not have saved them. The flow: the density endpoint is *not* PSD ($n_- = 5..12$; premise corrected by measurement), all 634 crossings upward and endpoint-determined, velocity-test ratio 1.00 — the amplitude gap *is* the metric margin rescaled; the index route closed with the typed residue (eigenproblem-free pivot certification, the crossing-location law). The one unclosed door typed: Fejér–Riesz of the total symbol = the positivity itself. No marker move, no RH claim. Machine-checked: [verification/v850_completion_tax_flow.py]. [E] (the exact identity and its certificates) + (MEASURED) (the divergence, the crossing census) + [O] (the wall unchanged)

The cluster decision and the graded kernel (PRIME.CELLCONE.KERNELFIELD.01 + PRIME.CLUSTER.MULT.01 + PRIME.CELLCONE.GRADEDKERNEL.01). One module from three probes over the read-only v847 parent (15 + 10 + 7 checks with the *six* frozen-honest FAILS kept and pattern-gated, not refit; verdicts CLUSTERS-DIFFUSE, BOTH-PARTIAL, KERNEL-GRADED, ~ 9 s). The cluster expansion is exact (sympy telescoping, Möbius elimination, 2^{16} -subset ward 0.0) but its weights are position-geometric (enrichment 0.883 vs bar 3.0; the scramble does not collapse it) — the corner route closes. The strict violation census wanders ($P_0 \sim X^{1.03}$, max 244333 vs cap 100) while the G1 depth- 10^{-2} kernel is bounded by $n \leq 73$ on all 67 rungs; the causal tube field transports clean (0/355199 on all four combos) but is self-calibrating (all four must-break controls do *not* fire; FIELD-STRUCTURAL-ONLY). The skin-depth law $D(X) = 0.754 X^{-0.548}$ ($R^2 = 0.99$, Kendall -1.00) with verified $X_0(\varepsilon)$ turns the wandering into vanishing-depth skin — the graded kernel+tail candidate registered [O] (bounds depth, not sign). No marker move, no RH claim. Machine-checked: [verification/v851_cluster_kernel_field.py]. (MEASURED) (the censuses, the skin law) + [E] (the exact resummation and congruence wards) + [O] (the registered graded candidate; the wall unchanged)

The bent CSS pair and the von Mangoldt commutator (ARF.BENT.CSS.01 + PRIME.RELATION.MANGOLDT.01). One module from two probes (22/22 + 30/30, verdicts ARF-BENT-CSS-EXACT and MANGOLDT-COMMUTATOR-EXACT, < 1 s). The canonical q^* is bent ($\hat{s}_q = -4s_q$ on all 16; $W^2 = 16I$), its zero set the (16, 6, 2) difference set; $A_q = [15, 5, 6]$ with the 31-word census; the CSS pair $[[15, 5, 3]] \rightarrow [[16, 4, 4]]$ with the vacuum transformation typed (the 60 minimal words = the 60 isotropic planes); the -4 triple point (Hecke = Gauss = Walsh = a_3) is one machine-checked integer; the 16 bent translates are the mutually unbiased partner of the v800 rays (reported, no upgrade). And the commutator theorem, typed honestly as classical incidence algebra: $\mathcal{L} = -M[D, Z] = -[D, \log Z] = T(\Lambda)$ exact three ways; powers = ordered factorization chains (nilpotency $\lfloor \log_2 N \rfloor + 1$); the four-comb discipline at operator level (the Epstein leak at $[6, 14, 21, \dots]$ exact and repaired by the class average $a_A + a_B = 1 * \chi_{-20}$; ideal-level Dedekind Λ_K); the carrier bridge — the deployed μ -pairing *is* the first row of $\mathcal{L}$. Controls fire. No marker move, no RH claim. Machine-checked: [verification/v853_bent_css_mangoldt.py]. [E] (exact identities; the operator algebra) + (TYPED) (classical content — the value is the packaging and the discipline transport)

Factorization cohomology (PRIME.RELATION.HODGE.01). One probe (18/18, verdict CURVATURE-DISCRIMINATES-ONLY, ~ 7 s). The factorization complex is exact ($d_1 d_2 = 0$ at entry level, $b_0 = 1$, $b_1 = 16/21/22$ on the same-prime exponent chords); the Euler connection from comb data alone gives multiplicativity *as* flatness at machine zero (true comb: $\leq 1.8 \times 10^{-15}$ on all squares); the Epstein curvature localizes at the class-group products (321/756/905 squares)

with the $\mathbb{F}_2$ Arf-lift obstruction *proven* (exact GF(2) rank vs augmented); gate 4 fails typed — the window form is 0-chain-supported (coboundary sensitivity $\sim 3 \times 10^4$), not a function of the cohomology class; the Pfaffian moonshot has no anchor-independent normalizer. No marker move, no RH claim. Machine-checked: [verification/v854_relation_hodge_pfaffian.py]. [E] (the exact complex and flatness wards) + (MEASURED) (the curvature census, the typed gate-4 failure) + [O] (the wall unchanged)

The invariance atlas (PRIME.CRITERIA.ATLAS.01 + PRIME.SUPPLY.SELBERG.01). One module from four probes over the read-only v850 frame library (19 + 8 + 7 + 3 checks, zero fails; spec v2 of the sieve probe declares its one bar recalibration in the frozen docstring; verdicts SIEVE-SAME-GAP, ATLAS-SAME-WALL, PROFILE-DIVERGES, DIRECTION-TRANSIENT, ~ 9 s). The demand rewritten exactly in Selberg-hierarchy coordinates and audited against on-range-verified elementary constants: the sieve reaches the $\alpha \in 1..2$ band in scope but zero coverage in grade (best factor 205 $\times$; the demand at 0.99–1.00 of τ_{pnt} ; the factor-2 gate unclosable at truth — input-class-invariant); the named sieve object: $d\text{Chain}_2$. The criteria align: $\lambda_n > 0$ to $n = 20$ unconditionally, d_N^2 exact to $N = 64$, $\text{BD} = 2\lambda_1$ (4.9×10^{-17}), the NB span *is* the spectral-mother geometry — yet the Li transfer fails by cone geometry (60.6% vs 5%): no coordinate system holds hidden supply. The minimizer: no frozen closed-form limit, but an internal direction exists (0.0217 rad) tracking the comb block’s own soft direction (0.0056 rad); the drift is real, no identification claimed, $-4/\pi$ typed a coincidence. No marker move, no RH claim. Machine-checked: [verification/v855_invariance_atlas.py]. (MEASURED) (the ledger, the atlas, the tracking law) + [E] (the exact hierarchy decomposition and identity wards) + [O] (the wall unchanged, now invariance-typed)

The connected covariance and the phase cells (PRIME.RELATION.CONNECTED_COVARIANCE.01 + PRIME.COFINAL.PHASE_CELL.01 + FORM.PRIME.COFINAL_CURRENT.01). One module from two probes plus the Lean frame (14/14 + 5/5, zero fails, verdicts CONNECTED-COVARIANCE-PARTIAL and PHASE-CELLS-EMPTY; +4 mirror checks). The centered KMS correlator of $\mathcal{L} = -[D, \log Z] = T(\Lambda)$ (exact at 7.2×10^{-15} ; Epstein $h=2$ leaks 76% off-pp at relation level) is PSD with the deployed main subtraction built in (corr 0.99) and *evades the nuclear tax* (relapse ratio ≈ 0.3 — the first design to do so); it dies on the grade gap: pair weights λ_m^2 (quadratic) vs the linear deployed form, variance price 2.5–4.1 $\times 10^5 \tau$. The phase-cell census is empty on the whole torus (0 positive of 220–1760 cells incl. {2, 3, 5, 7}; tail kill at -3.4 – $-4.8 \times 10^3 \tau$). The conditional frame (TfptCarrier/CofinalCurrent.lean, 7 theorems, axioms clean): three hypotheses $\Rightarrow$ (H_{cof}), composed to Weil nonnegativity — hypothesis 2 measured empty at the deployed frame: a continuation contract, not a discharge. No marker move, no RH claim. Machine-checked: [verification/v856_connected_current_lean.py]. [E] (the exact current and split wards) + (MEASURED) (the census, the relapse decision, the grade gap) + [O] (the wall unchanged)

The grade law and the elevator (FORM.PRIME.GRADE.NO_GO.01 + PRIME.EULER.SCHUR.SEMIGROUP.01). One module from one probe plus the Lean core (11/11, zero fails, verdict LOCAL-SIGN-FAILS; +4 mirror checks). The homogeneity no-go kernel-checked (TfptCarrier/GradeNoGo.lean, 10 theorems, axioms clean): grade-1 targets never live inside grade-2 Gram squares (two-scalar ray evaluation); the affine tax exact (error = two PSD prices); the sharpened no-go kills the background too; the elevator lemma (tangent_psd_on_kernel_null) licenses exactly one grade-1 mechanism: rates. The instantiation is real (PSD compound-Poisson factors, exact tangent, free null-sum positivity) and dies honestly: the comb Lévy density at exactly 50% negative mass (flip $\theta^* = \pi D/2u_q$ matched $\sim 1\%$), the arch signed on the digamma band ending $\tau^* = 6.27$ ($\text{Re } \psi(\frac{1}{4} + i\tau/2) = \log \pi$) — the Lévy/conditional-positivity elevator class closed on the deployed sides; Epstein $h=2$ refuses the Euler indexing (82% off-pp). No marker move, no RH claim. Machine-checked: [verification/v859_grade_no_go_elevator.py]. [E] (the kernel-checked law, the exact tangent wards) + (MEASURED) (the signed densities, the band constant) + [O] (the wall unchanged)

The phase-lever theorem (PRIME.PHASE.LEVER.01). One module from one probe (7/7, zero fails, verdict PHASE-LEVER-THEOREM). The finite-head phase-rescue family closed with certificates:

granting every atom a *private* best phase, the budget never pays the arch deficit on any of the 67 rungs ($d_0 - \text{budget}(\{2, 3\}) \geq 1.3894$; $d_0 - \text{budget}(\{2, 3, 5, 7\}) \geq 0.6296$) — uniformly negative at every phase, no Kronecker rescue; three certified tiers (exact census / budget inequality / greedy sharp control: the top-budget set’s exact landscape still has zero positive cells); the D-frontier saturates at $0.73 < 1$ (structural); the anti-vacuity ward fires ($1.87\times$). Not covered, typed: infinite P , non-canonical frames, non-tent interpolations. No marker move, no RH claim. Machine-checked: [\[verification/v860_phase_lever_closure.py\]](#). **[E]** (the warded routes and the analytic budget bound) + (MEASURED) (the censuses, the frontier saturation) + **[O]** (the wall unchanged)

The Krein normal form and the defect theorem (PRIME.KREIN.NORMALFORM.01 + FORM.PRIME.KREIN.DEFECT.01). One module from two probes plus the Lean frame ($37/37 + 8/8$, zero fails, verdicts DECK-MU-PARALLEL + REDHEFFER-ECHO-EXACT and KREIN-CONTRACTOR-STABLE-NO-WORD; +4 mirror checks). The deployed window form gets the exact Krein normal form $Q = \|B_+t\|^2 - \|B_-t\|^2$ (entrywise $\leq 10^{-15}$, both cuts; linear in Λ) with the Douglas pencil identity $1 - \|C_2\|^2 = \text{the } \tau\text{-margin}$ (3.9×10^{-9}); truth contracts on every rung, Epstein $h=2$ explodes to $\|C_E\| = 46.8$, the scramble to 3693; the 155-word census is empty. Two separate C_2 s (the identification one faithful- μ_4 character away, three candidates verified); $\det R_n = M(n)$ with SNF $(1, \dots, 1, |M(n)|)$; no floor–Mertens correlation ($\min 4p = 0.378$). The defect theorem kernel-checked (TfptCarrier/KreinDefect.lean, 10 theorems, axioms clean): contraction $\Leftrightarrow$ PSD (full-rank converse), SourceContractor the named hypothesis, composed to Weil nonnegativity. No marker move, no RH claim. Machine-checked: [\[verification/v861_krein_normalform_lean.py\]](#). **[E]** (the exact wards, the pencil identity, the kernel-checked frame) + (MEASURED) (the censuses, the discriminators) + **[O]** (the wall unchanged)

The rank-one defect, the monomial closure, and the weld law (PRIME.KREIN.DEFECT_ONE.01 + PRIME.MU4.WELD.01). One module from two probes ($8/8 + 22/22$, zero fails, verdicts DEFECT-ONE + MONOMIAL-CLOSURE-THEOREM and WELD-WITHOUT-CONTRACTOR). $\Delta = I - C^*C$ has exactly one soft mode on every rung ($\lambda_1 = \text{the } \tau\text{-margin}$ exactly; separation $3.9\text{--}14.1\times$); every source letter is monomial and the contractor’s monomial mass is $0.23\text{--}0.24$, so *every word of any length* misses by ≥ 0.874 (the 408 sign flips kill the corridor form, typed v2); the deck’s anticommutant is entirely faithful- μ_4 — the deck welds only as $J = MD$; all four candidates weld exactly, the unwelded control refuses exactly, the contractor connection is null ($\sqrt{2}$). No marker move, no RH claim. Machine-checked: [\[verification/v862_defect_polar_weld.py\]](#). **[E]** (the pencil ward, the exact weld censuses, the closure theorem) + (MEASURED) (the polar microscopes) + **[O]** (the missing letter specified, not found)

The Redheffer colligation (PRIME.REDHEFFER.COLLIGATION.01). One module from one probe ($7/7$, zero fails, verdict COLLIGATION-CONTRACTS-NOT-IDENTIFIES). Both source-built 16-slot machines exactly unitary (10^{-12}); the vacuum-port closure well-posed ($\|D\| = 1/4$); every closed block *automatically* contractive; the scalar limit is the weighted lattice Redheffer determinant exactly ($\mathbb{F}_2^4 = \text{the divisor lattice of } 210$, Walsh–Hadamard carries lattice μ , $\det = 8/35$); the machine provably comb-blind. The identification gate fails honestly (residual 1.38 vs bar 10^{-8}) with the gap typed: the contractor couples *different* $|\tau|$ bands, the J flip couples equal $|\tau|$ — the missing object is the grid-side band intertwiner. No marker move, no RH claim. Machine-checked: [\[verification/v863_redheffer_colligation.py\]](#). **[E]** (unitarity, closure, the exact scalar determinant) + (MEASURED) (the identification gate, the band census) + **[O]** (the intertwiner missing)

The soft port and the kappa law (PRIME.SOFTPORT.FESHBACH.01 + PRIME.POLEPORT.KAPPA_LAW.01). One module from two probes ($5/5 + 6/6$, zero fails, verdicts SOFTPORT-FOUND + CAUCHY-RANK-SMALL and KAPPA-LAW-PARTIAL). The exact Feshbach reduction: $\tau > 0 \Leftrightarrow s > 0$; four source ports pass (cheating-port ceiling $\kappa \equiv 1$ exact); the pole port carries 84% of the soft mode with $\kappa^{-1} = \beta^2 + \lambda_1\rho$ exact and the closed-form a -term (Poisson kernel at $s = 1/2$); $\kappa - 1 \approx 6e^{-\alpha/2} \rightarrow 1$ (Pearson -0.99); the backflow concentrates on ≤ 17 bulk modes cancelling 99.9%; displacement rank ~ 12 fixed over $3.9\times$ dimension, generators = arm weights, pure rank- ≤ 2 Cauchy excluded. Both discriminators break at the premise. No marker move, no RH claim.

Machine-checked: [\[verification/v864_softport_kappa_law.py\]](#). **[E]** (the Feshbach wards, the exact skeleton) + (MEASURED) (the kappa law, the rank tables) + **[O]** (the coupling bound missing)

The Weyl port and the repaired readout (PRIME.WEYL.PORT.01 + PRIME.WEYL.READOUT.01). One module from two probes (9 checks with the two frozen-honest FAILs S1.SPR + S4.RSP kept and pattern-gated + 5/5, verdicts WEYL-PORT-BLIND and READOUT-REPAIRED). The divisor-tower Weyl load carries the comb at $O(1)$ (the hull's comb-blindness repaired at load level); the v1 extremal readout dies by a diagnosed mechanism (doubling = near-reparametrization, exactness ward 10^{-10}); the repaired phase readout discriminates: Epstein $\kappa = 42.7$ / scramble 77.6 outside the $1.5\times$ truth window — 1–2 orders where every earlier functional had both inside; typed caveat carried: Spearman(s, τ) = -0.8 , the discrimination is the load-bearing content. No marker move, no RH claim. Machine-checked: [\[verification/v865_weyl_port_readout.py\]](#). **[E]** (Herglotz/passivity wards, the exactness ward) + (MEASURED) (the discrimination, the kappa band) + **[O]** (the kappa law underived)

The SourceContractor formula and the Perron closure (PRIME.SOURCECONTRACTOR.NORM.01 + PRIME.KREIN.CONTRACTOR.01). One module from two probes (10 checks with the frozen-honest FAIL S2.2 at exit code 1 + 8/8, verdicts SYLVESTER12-ANGLES-FAIL and NORM-REFORMULATION). The headline: $C = W_- F G_+^{-1} F^H W_+$ exactly (1.4×10^{-14} , blind holdouts; no zeros, no τ , no fit) with certified defect transfer on all seven rungs; the rank-12 reading corrected to $\sqrt{L}$ growth ($k^* = 24.48$); $\|C\| \leq 1 \Leftrightarrow G_- \preceq G_+$ exactly; the Perron closure: $\rho(|C|) = 2.4\text{--}3.1 > 1$ everywhere — no absolute Schur/Hilbert test can ever certify; Epstein/scramble through the same formula match their direct norms. The named demand registered: one phase-aware kernel bound. No marker move, no RH claim. Machine-checked: [\[verification/v866_source_contractor_formula.py\]](#). **[E]** (the factorization, the Loewner equivalence, the Perron proof) + (MEASURED) (the transfer, the bands) + **[O]** (the certificate itself — the registered demand)

The quadrature reach and the intrinsic conditioning (PRIME.SOFTPORT.RADAU.01 + PRIME.PORT.CONDITIONING.01). One module from two probes (7 + 8 checks with the two frozen-honest FAILs S2.G2 + S3.G kept and pattern-gated, verdicts RADAU-DEPTH-GROWS and CONDITIONING-INTRINSIC + J-INFINITY-NAMED). Gauss–Radau certificates for $s > 0$ exist on *every* rung ($m^* \leq 426$; the Neumann frontier killed) but the depth grows as $m^* \sim \sqrt{\text{cond}(G)}$ (Spearman +0.99); the $m \approx 17$ prediction honestly failed (0/7); all three source preconditioners fail informatively (no healing; Sylvester control passed): the conditioning is intrinsic — the certificate depth is the price of the cancellation. J_∞ named: the free Chebyshev chain on the bulk support (Rakhmanov-generic typed). No marker move, no RH claim. Machine-checked: [\[verification/v867_radau_conditioning.py\]](#). **[E]** (the enclosure and monotonicity wards, congruence invariance) + (MEASURED) (the depth law, the conditioning trends) + **[O]** (the uniform certificate missing)

The 210 canonicity guard and the two burials (E8.DIVISOR210.CANONICITY.01). One module from three probes (36/36 + 12/12 + 15/15, zero fails, verdicts DIVISOR210-GAUGE-FAMILY(2), MOVING12-DIMENSION-ONLY, CHIRALITY-DEGENERATE). The Boolean layer is measured generic (210/210, as warned); the Euler determinants pin $\{2, 3, 5, 7\}$ uniquely; the anchor prime 2 forced by ramification; the gauge cut $C_6 \rightarrow C_3$; two classes remain — the chirality pair, then *proven gauge* by two exact no-go wards (the orientation functional vanishes identically via the Möbius complement; quadratic readouts provably blind by transposition); the $17 = 12+3+1+1$ identification buried at space level (principal angles $\sim 90^\circ$); the 6-vs-7 note stands. No marker move, no RH claim. Machine-checked: [\[verification/v868_divisor210_audits.py\]](#). **[E]** (exact censuses, the no-go wards) + (MEASURED) (the burial angles) + **[O]** (nothing upgraded)

The Christoffel–Darboux identification and the Clark falsification (PRIME.CONTRACTOR.CDCORE.01 + PRIME.CONTRACTOR.CLARKPHASE.01). One module from two probes (10 + 8, zero fails, verdicts CDCORE-IDENTIFIED + CLARKPHASE-DEAD). The kernel is *named*: K_+ is exactly the CD kernel of an explicit source measure in $x = 2\cos(D\tau)$ — displacement rank exactly 2

(gap $\geq 6.6 \times 10^{12}$) on all seven rungs incl. blind holdouts; the firewalled chain-only reconstruction rebuilds C at $\sim 10^{-13}$; the contractor = arm weights + phase/geometry factors + one source Jacobi chain. Honest boundary typed pre-run: the collapse is window geometry (the controls collapse too) — the arithmetic is the chain and the weights ($O(1)$ off for the fakes). The μ_4 quarter-turn Clark phase dies sharply: the equal-phase coupling law (offset $\sim 0^\circ$ at $\bar{R} \geq 0.97$), the rank leg at 85–99, the phase coordinate itself source-only clean. No marker move, no RH claim. Machine-checked: [\[verification/v869_cdcore_clarkphase.py\]](#). [E] (the frame factorization, the reconstruction wards, the circularity fence) + (MEASURED) (the collapse tables, the offset law) + [O] (the chain/weight control missing)

The factorization and the frame decision (PRIME.CONTRACTOR.CHRISTOFFEL.01 + PRIME.CONTRACTOR.GAUSSNODE.01). One module from two probes (17/17 + 9/9, zero fails, verdicts CHRISTOFFEL-PARTIAL + GAUSS-STILL-DEFECTIVE). $C = D_-UD_+$ exactly (10^{-14}); $\|D_+\| \leq 0.9654$ by the Christoffel variational theorem, $\|D_-\| \leq 0.8655$ measured; U non-unitary *by theorem* ($2\times$ -oversampled folded pairs: rows ≥ 1.158 , the $\sqrt{2}$ over-normalization). The Gauss frame: $D_+^G = I$ exact, bridge lossless, port share frame-invariant — yet the co-isometry defect stays $O(1)$ (0.93–1.30, near-pole misalignment); the surviving asset $D_-^G \leq 0.997041$ ladder-wide with $34\times/2900\times$ discrimination; hypotheses (H-D)/(H-U)/(H-PORT) registered. No marker move, no RH claim. Machine-checked: [\[verification/v870_christoffel_gauss_frame.py\]](#). [E] (the assembly, the variational and row theorems, the quadrature-exact frame) + (MEASURED) (the defect census, the damping bound) + [O] ((H-U) open)

The measure-relation closure (PRIME.JACOBI.POLE.UVAROV.01 + PRIME.GAUSS.CROSSDEFECT.01). One module from two probes (7+11, zero fails, verdicts POLE-TRANSFORM-DEAD + CROSSDEFECT-DIFFUSE). None of Uvarov/Christoffel/Geronimus is exact or fixed-small-rank at $x_{\text{pole}} = 2\cosh(D/2)$ (machinery warded on synthetics at 9.2×10^{-16}); typed residue: small-negative-mass Geronimus uniformly closest (3.5–8.1% Weyl, non-growing, discriminating) — misses the bar, no $\lambda(D)$ law. The co-isometry defect is diffuse: full-rank, linear in h (Pearson + 0.996), pole removal changes nothing, the $U_0 + R$ bracket $O(1)$ near-full rank — no finite-matrix compensation. Stop-listed both ways; the Prüfer route preregistered as plan B. No marker move, no RH claim. Machine-checked: [\[verification/v871_pole_uvarov_crossdefect.py\]](#). [E] (the machinery wards, the traceless/ τ wards, the PSD base theorem) + (MEASURED) (the residue tables, the rank growth) + [O] (nothing upgraded — two escapes closed)

The compensation identity (PRIME.CD.DAMPING.COMPENSATION.01). One module from one probe (10, zero fails, verdict COMPENSATION-EXACT). $I - C^*C = T_1 + T_2$ exactly (10^{-12} on all 42 rungs): $T_1 = I - U^*U$ the indefinite Jacobi cross-geometry, $T_2 = U^*(I - D_-^2)U$ the PSD Christoffel damping; the exact global minimizer *is* the soft direction (overlap ≥ 0.9991 ; min ratio $= 1 + \tau/|v^*T_1v|$ to all digits); $\Delta = \Delta_{\text{bulk}} + s\,pp^*$ with the certified bulk floor (98–100% of λ_2) and $s = \kappa\tau$; the wall as two source numbers ($-0.0328 + 0.0330 = 1.68 \times 10^{-4} = \tau$ at kz 9). Honesty line typed: the truth-side ratio ≥ 1 is implied by upstream positivity — the identity buys the form. Epstein/scramble break the damping's sign and under-compensate on their own soft directions. No marker move, no RH claim. Machine-checked: [\[verification/v872_damping_compensation.py\]](#). [E] (the split/transport/deflation wards, the T2 sign theorem) + (MEASURED) (the alignment anatomy, the discrimination) + [O] (the two-term inequality at the soft direction — the open cofinal content)

The Cotlar decision — the executed preregistration (PRIME.PRUEFER.COMPENSATION.01). The program's first fully preregistered uniformity test, executed (composite verdict COTLAR-GROWING / route dead by the contract's own frozen rules). Provenance chain machine-warded: contract frozen + hashed (spec SHA 4621b899... , 8/8 freeze wards) $\rightarrow$ committed byte-exact *pre-execution* in round-34 commit 526ca3eb (file SHA 93208a1b...) $\rightarrow$ unfreeze flag with committed audit line $\rightarrow$ executed with two documented mechanical fixes (the $h \leq 900$ battery filter the spec's own text mandates; the overflow renormalization, atan2-invariant, $\leq 6.6 \times 10^{-4}$ vs a 60-digit `mpmath` reference), spec literal SHA byte-identical throughout. The verdict: danger geometry *real* (the predeclared cells capture 0.98–0.61 of $\lambda_{\min}(T_1)$, source-only — kill 3 silent);

local dominance and envelope decay FAIL (Spearman $-0.17..0.00$ vs ≤ -0.8 ; bimodal at the predeclared π -resonance cells); the battery flat (S_U 5.55–6.30) but the frozen deep holdouts explode (kz 142: 32.07/58.78; slopes 0.209/0.408 ≥ 0.20 , both channels GROWING); contrast bars pass (Epstein 3927%, scramble 314462% — kill 4 silent); kills 2 + 5 fire; RUN 3 correctly withheld. Carry-forward: the growth tracks kz-depth (α), *not* h ; the surviving demand is a non-stationary phase bound. The honest FAILs pattern-gated, nothing refit. No marker move, no RH claim. *Dated correction (round 36)*: the deep-holdout data was comb-truncated (ATOM_MAX artifact); the verdict stands as-measured, but on complete combs the identically frozen rule returns BOUNDED and the route reopens — the α -not- h law is retired (see the v877 card below). Machine-checked: [verification/v873_pruefer_cotlar_decision.py]. [E] (the provenance wards, the partition/node wards, the frozen decision rules applied verbatim) + (MEASURED) (the anatomy and Cotlar censuses) + [O] (nothing upgraded — one route closed by its own contract)

The Carleson wave (PRIME.PHASE.POLYGON.01 + PRIME.RESIDUAL.QUADRATURE.01 + PRIME.PI.RESONANCE.ANATOMY.01). Three probes (6/8 + 7/8 + 5/5 with the three frozen-honest FAILs pattern-gated at exit 1, nothing refit). The Carleson ward: $\lambda_{\max}(M_-) = \|C\|^2 = 1 - \tau$ at rel 1.5×10^{-13} — arrows (i)–(iii) of the embedding chain machine-exact, the target registered (PRIME.CARLESON.PRIME.01 [O]). The polygon $S_0 \geq |S_2|$ breaks on all 47 rungs at $2\theta \approx 1.5\pi$ (typed: the wrong compression of the Loewner order); holonomy null with inverted contrast. The residual quadrature realizes ρ_h at *full degree* on all 44 floor-positive rungs (k^*/h median 1.000, slope 0.974; mp escalation past the 53-bit wall; single atom just beyond the pole port; discrimination 7–9×); its three stalls were exactly the truncated combs (validated detector, v877). The resonance is *thick* ($\sim 1/5$ constant, excision gains nothing, soft direction disjoint): the wall is phase-distributed. No marker move, no RH claim. Machine-checked: [verification/v876_carleson_polygon_wave.py]. [E] (Lemma A, the Carleson ward, the horizon law) + (MEASURED) (the polygon/holonomy/resonance censuses) + [O] (the embedding contract — the surviving target)

The artifact resolution and the Cotlar reversal (PRIME.DEEPALPHA.SIGN.01 + PRIME.PRUEFER.COMPENSATION.02 + PRIME.TRUNCATION.AUDIT.01). Two probes (8/8, DEEP-ALPHA-ARTIFACT; 9/9, COTLAR-BOUNDED-V2). The negative floors at kz 142/177/243 were *comb-truncation artifacts* (build_window silently caps at ATOM_MAX = 4×10^5 ; those windows demand up to 1.8×10^6): complete-comb certified enclosures strictly positive ($+1.06/ +1.52/ +1.20 \times 10^{-5}$), no negative canonical window, the kz-121 ladder end a *data* boundary, (H_{cof}) unaffected; the silent truncation typed as an infrastructure bug (loud-guard follow-up registered). The reversal: under the *identically* frozen v1 bars (v1 spec SHA re-verified; single change warded) the complete-comb deep sums collapse into the battery band (32.07 $\rightarrow$ 5.65 etc.), both channels BOUNDED (slopes 0.006/0.007), RUN 3 unlocks and passes (K_1/K_2 h -stable on all five holdouts) — the v1 kill was entirely the artifact; the route *reopens*; remaining gap typed ($B_C \sim 4$ vs 1; local defects 7–10). The audit table re-types every affected finding (pruefer v1 confounded $\rightarrow$ re-decided; residual strengthened; resonance α -law void; polygon holdouts numeric-void; the other waves unaffected). v873's booking stands as-measured. No marker move, no RH claim. Machine-checked: [verification/v877_complete_comb_reversal.py]. [E] (the certificates, the frozen-bar re-decision, the wards) + (MEASURED) (the audit table) + [O] (bounded is not contracted — the gap typed)

The partition closure (PRIME.PARTITION.CLOSURE.01). Two probes (7 checks with the two frozen-honest FAILs T1.4/C.1 pattern-gated at exit 1, ENVELOPE-EMPIRICAL-ONLY; 6/6, PARTITION-CLASS-CLOSED; the round-34 $\rightarrow$ 37 contract chain machine-verified at run time). The analytic core: multiplication by $\cos \theta$ is *exactly* tridiagonal on the odd frame (mirror-closed boundary, rank-2 defect at $k = 0$; CD telescoping at 1.3×10^{-13} on every rung incl. all five complete-comb holdouts), and the derived pointwise bound carries h -uniform source constants ($C_{\text{int}} \in [1.232, 2.328]$, $h = 168$ to 1445, slope +0.106) — the route's first analytic uniformity statement, entrywise grade; C_{int} discriminates (1.41/3.59/12.8). The closure: the cell-envelope decay is cancellation-carried (provably not entrywise-derivable; the honest FAILs kept); no predeclared cell accounting below 3.568 (bar 1);

$\sum_r \varepsilon_r = 6.9\text{--}12.9$ α -uniform on clean data; and honest tight wave-packet frames on both natural phase spaces ($\|B\| = \|C^G\|$ exact; the Gabor envelope decays — the first partition to show decay; discrimination 4.985 vs 128.7 vs 9006.6) leave diagonal mass $\leq 18\%$ under any pairing with a growing Schur constant ($4.985 \rightarrow 9.222$, slope $+0.295$). The cancellation is *atomically global*: no partition-based accounting (cells, packets, frames) can certify; the certificate demand retyped *non-decompositional*; wave-packet partitions and entrywise envelope bounds stop-listed. No marker move, no RH claim. Machine-checked: [\[verification/v879_envelope_partition_closure.py\]](#). [E] (the CD identity, the derived bound, the tight-frame and contract-chain wards) + (MEASURED) (the gap anatomy, the packet censuses) + [O] (the non-decompositional demand — the surviving target)

The Carleson port geometry (PRIME.CARLESON.PRIME.01 constraints extended). Four probes ($11/11 + 5/5 + 8/8 + 5/5$; PICK-SCALARIZED, TESTING-IDENTIFIED, PORT-SCHUR-EXACT, INTEGRABLE-CONFIRMED; embedded byte-exact). The literal rank-2 Pick target $I - C^*C = \Gamma^*\Pi\Gamma$ refuted as stated (defect full-rank); instead the exact rank-2 Jacobi displacement $[J, \Delta] = b_h(e_{h-1}r^\top - re_{h-1}^\top)$ (4.3×10^{-14} , source-only, kz 9/12/13 + blind holdouts 26/40); at the Gauss nodes $\Delta = I - b_h^2\Phi C C^\top\Phi$ (Cauchy–Gram of the positive ω ; scalar Herglotz carrier $v = b_h m_\omega$ exact); $\|C_h\| \leq 1 \Leftrightarrow b_h^2 C^\top\Phi^2 C \preceq I$ with $\lambda_{\max} = 1 - \tau$ exact (9.5×10^{-13}). The gauge identity $E = S(\sqrt{\bar{\nu}}K_{CD}\sqrt{\bar{\nu}})S$: the wall orthogonally equivalent to the plain Carleson Gram, diagonal = the classical testing functional, margin $1 - T_h \sim h^{-0.70}$, port atom-carried (arch share 0.016–0.178). The port Schur reduction: $I - E \succeq 0 \Leftrightarrow I - R \succeq 0 \wedge I - D_P \succeq 0$; Haynsworth inertia integer-exact incl. both indefinite controls (Epstein 55 = 48 + 7, scramble 37 = 30 + 7); $(1 - \lambda_{\max}(D_P))/\tau = 1.00$ on all rungs — the port (13–54 nodes, $\approx 15\%$) *is* the wall; bulk margin $420\text{--}45000 \times \tau$; cut-robust at 10^{-4} — the round-37 non-decompositional demand satisfied as typed. The integrable surprise: $[Y, P]$ and $[Y, D_P]$ both rank 2 *exact* (10^{-14}) — the Schur dressing preserves the IIKS class. No marker move, no RH claim. Machine-checked: [\[verification/v881_carleson_port_geometry.py\]](#). [E] (the displacement, gauge, Schur and inertia identities — exact) + (MEASURED) (margins, shares, slopes) + [O] (one-sidedness — open at RH strength)

The port source law (PRIME.ERRORTERM.SCALE.01 decided; the port contracts registered). Three probes ($7/7 + 5/5 + 6/6$; SQRT-UNIFORMIZED, MELLIN-SOURCE-CONFIRMED, BUDGET-CLOSED; embedded byte-exact). Under $r = \sqrt{n/X}$ the weighted prime measure $\eta_X = \frac{1}{4\sqrt{X}} \sum 2\Lambda(n)n^{-1/2}\delta_r$ converges to Lebesgue (Kolmogorov $0.0148 \rightarrow 0.0005$ over $X = 10^4\text{--}10^7$, own SPF sieve; moments 2×10^{-4} ; the deployed rung tables are the true comb at 0.0033); the last-log-unit edge mass $1 - e^{-1/2} = 0.393469$ (measured 0.3936) — the wall's $\sim 39\%$ port mass *is* the classical PNT edge law (Epstein uniformizes too — the arithmetic lives in the fluctuations; scramble breaks hard). The port symbol is the Mellin–Cauchy kernel $1/(1 + 2i\tau)$ (0.0004 at 10^7); the fit-free continuum prediction reproduces the deployed port numerators to 0.029 at the deepest rung ($0.375 \rightarrow 0.029$ — the shrinking arithmetic fluctuation); the port numerators are the *exact* deployed-window prime sums (1.5×10^{-13}), matching $-\sum 2\Lambda(n)n^{-1/2}\cos(\tau_j \log n)$ at the alias frequencies $\tau_j = \theta_j/D$ to tent order. The budget closes: $+1.405 - 1.674 + 0.284 = +0.015 = d \log T/d\alpha$ — the wall is a prime error-term statement at the port frequencies; the hardness decided (PRIME.ERRORTERM.SCALE.01: exact reformulation at RH strength, no unconditional slack). No marker move, no RH claim. Machine-checked: [\[verification/v882_port_source_mellin.py\]](#). [E] (the numerator identity, the budget, the kernel fit wards) + (MEASURED) (the uniformization convergence, the edge mass) + [O] (the limit theorems — the registered port contracts)

The tau chain and the parametrix decision (PRIME.PORT.TAU.01 [O]; PRIME.PORT.LATTICE.PARAMETRIX.01 decided). Three probes ($5/5 + 3/3 + 3/3$; TAU-CHAIN-EXACT, PARAMETRIX-MEASURED (FLUCTUATIONS-REQUIRED), ZONES-MEASURED (BOTH-REQUIRED); embedded byte-exact). The Schur determinant identities $\sigma_h = \det(I - E)/\det(B)$ and $\det(I - E) = \det(I - R)\det(I - D_P)$ machine-exact (4.8×10^{-13} in log space) with positive bulk factors, hence $\text{sign } \tau_h = \text{sign } \sigma_h$ = the wall with $\tau_h := \det(I - D_P)$; the Jacobi variational identity holds on the true family (10^{-6}); the wall indicator false on both controls; the κ/ρ readout slope($\log \sigma$) = -2.93 vs $2 \times$ the Mellin fluctuation slope -2.53 ($\sigma \sim \text{fluctuation}^2$ within 16%). The parametrix decision: true comb

$+1.7 \times 10^{-4}$ to $+6.7 \times 10^{-7}$; lattice with smooth masses -78 to -1706 ; exact local-PNT masses -78 to -5537 ; continuum -0.11 to -1.26 ; zones: edge-only smoothing -3.7 to -22.1 , interior-only -77 to -7551 — the Euler-product pairing is globally rigid; every smoothing-based parametrix is dead; the small parameters live only in the flow/deformation direction. No marker move, no RH claim. Machine-checked: [\[verification/v883_tau_chain_parametrix.py\]](#). **[E]** (the determinant and variational identities — exact) + (MEASURED) (the parametrix and zone censuses, the κ/ρ readout) + **[O]** (the symbolic IKS tau theorem — the demand; since executed at the finite-identity level, PRIME.PORT.TAU.FINITE.IKS.01 **[E]** via [\[verification/v955_tau_iiks_toda_dictionary.py\]](#), with the sign question refined to PRIME.PORT.TAU.NOPOLE.COFINAL.01 **[O]**; the umbrella stays **[O]** for the fully symbolic arbitrary- h statement)

The certified head (PRIME.PORT.CERTIFIED.HEAD.01, delivered). One probe (5/5; CERTIFIED-HEAD; embedded byte-exact; SPEC v2 amendments on record). $\sigma_h > 0$ proven on $kz\ 9$ ($h = 184$), 12 (151), 13 (168) — the program's first rigorous positivity statement: independent `mpmath` lag rebuild (dps 60/100; conservative error model $\varepsilon_c = 10 \times$ dps-disagreement; cross-ward 1.1×10^{-14} , which caught a sign bug in the rebuilt Arch near-branch), matrix shift $\sim 2 \times 10^{-18}$ (~ 14 orders below the margins), exact integer Bareiss/LDL on the $Q = 10^{20}$ grid — all pivots positive (Sylvester) $\Rightarrow K \succ 0 \Rightarrow \sigma_h > 0$ via the exact v866 equivalence; no Lanczos, no floating point in the decisive step; certified floors $\lambda_{\min} \geq 3.633/3.327/3.842 \times 10^{-4}$; the Epstein control refused at pivot index 10. Proven modulo the declared conservative transcendental-evaluation error model; the ball-arithmetic closure and the 42-rung rollout were the named follow-ups — both since delivered (v887; [\[verification/v897_certified_interval_ladder.py\]](#): rigorous interval shifts, the informal error model retired) — the head part of PRIME.PORT.TAIL.01 delivered on three rungs. No marker move, no RH claim. Machine-checked: [\[verification/v884_certified_head_positivity.py\]](#). **[E]** (the integer Sylvester certificates — exact, modulo the declared evaluation error model; interval-rigorous since v897) + **[O]** (the Lean composition and the asymptotic tail — the remaining named steps)

The flow and induction anatomy (PRIME.PORT.ISOFLow.01, PRIME.PORT.LADDER.TRANSFER.01, PRIME.PORT.PRIMELADDER.01, PRIME.PORT.LAX2.01). Four probes (8/8 + 5/5 + 13/13 + 11/11; ISOFLow-MEASURED (FLow-OPEN), LADDER-MEASURED, PRIMELADDER-MEASURED, LAX2-MEASURED; embedded byte-exact). The generator flow closes in degree 2 (0.244/0.248 vs degree-1 0.498/0.457; isomonodromy-compatible; a structural precondition — the controls close too, the arithmetic stays in the value); the window-ladder step is marginally perturbative (0.458) but non-monotone in raw h ; the one-prime ladder: the pure-Arch start is catastrophically subcritical ($\tau(0) = -9.9 \times 10^{13}$; G_+ not PD deeper), the last sign crossing sits at $u^*/U = 0.991$ – 0.999 in every insertion order, edge-first needs 100% of the atoms — positivity is a property of the complete comb (v877 sharpened to atom resolution; no monotone one-prime induction); the raw degree-2 coefficient basis is ill-conditioned noise (1.365 vs 0.7; predictivity 0.350 vs 0.3) while the integrated tau-transfer identity is warded exact (5.6×10^{-11}). No marker move, no RH claim. Machine-checked: [\[verification/v885_ladder_flow_anatomy.py\]](#). **[E]** (the integrated tau-transfer identity, the per-atom linearity and endpoint wards — exact) + (MEASURED) (the flow closure, the ladder and insertion censuses) + **[O]** (the conditioned flow coordinate — the named open object; since adjudicated LAX1-H-EXACT in round 225: the true minimal degree in the closing direction is one, and the closing direction is h , not s — [\[verification/v955_tau_iiks_toda_dictionary.py\]](#))

The gapcode disenchantment (PRIME.DIVISOR210.GAPCODE.01). One probe (24/24; GAPCODE-MEASURED; an honest negative/limit row; five SPEC amendments on record, none loosening a criterion). The register bits $\{2, 3, 5, 7\}$ are the first four parity checks of the sieve (rate 48/210, 16 syndromes, 0 bits of message capacity); the hard floor $g_k \geq w(p_k \bmod 210)$ holds with zero violations in 5.76×10^6 pairs; $I(\text{state}; \text{gap}) = 1.14$ bits — and the code is the sieve: a zero-parameter wheel–Cramér null explains $R^2 = 0.99839$ of the state profile, the excess is 4.02% and shrinking, no knee at four checks, 210 on the foreign-wheel trend ($z = -0.61\sigma$). Nothing moves with c_3 or φ_0 ; the register's uniqueness stays $\prod(p-1) = 48 = \Omega_{\text{adm}}$ (v868). No marker move, no RH claim. Machine-checked: [\[verification/v886_register_gapcode_null.py\]](#). **[E]** (the parity-check identification, the floor

census — exact) + (MEASURED) (the wheel–Cramér null, the excess ladder — the disenchantment)

The complete certified ladder (PRIME.PORT.CERTIFIED.LADDER.01, delivered). One probe (7/7; CERTIFIED-LADDER-COMPLETE; embedded byte-exact). $\sigma_h > 0$ proven on *all* 42 reachable rungs of the deployed window ladder: 12 rungs ($h \leq 300$) exact-rational integer Bareiss/LDL + 30 rungs validated-precision `mpmath` Cholesky at dps 120/200 (precision doubling; every pivot $> 10^6 \times$ the accumulated per-pivot rounding bound at both precisions); 0 refusals, 0 out-of-reach; the module closes the two deepest rungs $h = 859/878$ with floors $\geq 8.352/9.187 \times 10^{-6}$ and pivot-to-bound ratios $\sim 10^{115}/10^{195}$; the Epstein control refused at pivot index 10 by the identical machinery; the 40-rung parent rollout stays sandbox, runtime-excluded. Proven modulo the declared conservative lag-evaluation error model (validated-numeric standard; the validated-precision tier is never labeled exact-rational); the ball-arithmetic closure and the Lean composition are the named remaining steps; the asymptotic tail is untouched. *Interval note (round CXV):* the error model is upgraded — `[verification/v897_certified_interval_ladder.py]` (PRIME.PORT.BALLLADDER.01) re-proves all 42 rungs with rigorous interval-arithmetic shifts (15 exact-rational + 27 validated-precision; Epstein refused at pivot 10); the informal ε_c model is retired from the ladder, and only the Lean composition remains named. No marker move, no RH claim. Machine-checked: `[verification/v887_certified_ladder_complete.py]`, `[verification/v897_certified_interval_ladder.py]`. [E] (the integer and validated-precision Sylvester certificates — interval-rigorous since v897) + [O] (the Lean composition and the asymptotic tail — the named follow-ups)

The four route decisions (PRIME.PORT.DIAGSEP.01; PRIME.CASE.ZONESPLIT.01; PRIME.CASE.PNTGAMMA.01; PRIME.CASE.SIGNEDHOMOTOPY.01). Four probes (8/8 + 12/12 + 10/10 + 12/12; DIAGSEP-MEASURED (DIAG-INTERMEDIATE), ZONESPLIT-MEASURED (ZONE-FROZEN($\theta^* = 0.700$)), PNTGAMMA-MEASURED (PNT-INSUFFICIENT), HOMOTOPY-MEASURED (HOMOTOPY-INDEFINITE-ARITHMETIC); embedded byte-exact; SPEC v2 amendments on record). The wall dies 100% through off-diagonal coherence (the diagonal profile frozen at the kill point; separation 2.0–2.7 head, > 10 deep); the critical zone freezes at $\theta^* = 0.700$ (outside margin +0.0214 uniform on 42 rungs; inside law $\sim 0.87/\log^2 h$; kz 13 outlier flagged); PNT is insufficient (the smooth reference violates the port margin on every rung, -0.96 to -7.8×10^{-3} ; the positivity is the mask–mass interaction; ε_A is 6–970 $\times$ too large); and the signed-homotopy classification (envelope identity exact at 4.3×10^{-14} ; kernel concavity-locked NSD; the diagonal input is *pair-correlation class*) — PRIME.CASE.SUMRULE.01 retyped from unconditional candidate to conditional reduction theorem. No marker move, no RH claim. Machine-checked: `[verification/v889_route_decisions.py]`. [E] (the null wards, the envelope identity, the exact tent-integral construction) + (MEASURED) (the separation, zone, gamma and homotopy censuses — the route decisions)

Flag positivity (Sylvester), the s -corridor, and the multi-factor anatomy (PRIME.PORT.HIROTA.01 [O]; PRIME.PORT.TAU.MOEBIUS.01). Three probes (10/10 + 7/7 + 14/14; HIROTA-MEASURED (MINORS-POSITIVE), SFLOW-MEASURED (CORRIDOR-CLEAR), TAUMOEBIUS-MEASURED (BRIDGE-DIFFUSE); embedded byte-exact). All twelve nested leading principal minors of $I - C_h$ strictly positive on 37/37 full-window rungs (total positivity — strictly stronger than the wall scalar); Desnanot–Jacobi exact on every rung, section and s ; the s -corridor $[0, 1]$ pole-free on every rung (controls pull their pole inside) with the organizing identity $s_h^* = 1/\lambda_{\max}(C_h)$ — the wall margin is the pole distance (slope -2.90); the exact factorization $Q_h = \prod_i (1 + \mu_i)$: the truth keeps every factor off -1 on 31/31 steps while the smooth-mass world crosses on 22/28 and flips Q thirteen times; the one-scalar Möbius bridge closed (BRIDGE-DIFFUSE; $|\alpha| \sim 10^{-3}$ determinant-inert) — inheritance is a multi-factor/total-positivity statement. The raw- h bilinear closure honestly open (median 0.655); the derivation from the IKS generators is the demand. No marker move, no RH claim. Machine-checked: `[verification/v890_total_positivity_flow.py]`. [E] (the Desnanot–Jacobi, variational and factorization identities — exact) + (MEASURED) (the minor, corridor and factor censuses) + [O] (the propagation theorem — the named open object)

The Möbius kill battery (PRIME.PORT.MOEBIUS.KILLS.01). Three probes (10/10 + 13/13 + 7/7; CRFIREWALL-MEASURED (CR-DEAD), GAUGEFW-MEASURED (GAUGE-MADE), MOEBIUSCENSUS-

MEASURED (UNDECIDED); embedded byte-exact; the verdicts are kills and are recorded as such). The carrier-invariance finding was a normalization artifact: fit-free cross-ratios over 8126 quadruples give pooled median defect 0.128 (bars $10^{-3}/10^{-2}$), anchors disagree, steps do not compose; no source-frozen gauge is raw-invariant (two degenerate, one moving; the scalar cocycle does not track the wall, $\text{corr} = 0.13$; Jacobi dead at $d_P = 0.997$); the six-world census: every control world loses window subcriticality (truth 41/41, controls 0) — the arithmetic separates *at the frame* — and scramble beats truth on the bare Möbius bars (0.0060/0.0011 vs 0.0218/0.0446): rank-2 kinematics, not arithmetic. The surviving remnant: the deep-core 8-node coherence (4.3×10^{-4} vs smooth 2.7×10^{-2} — prime-mass-driven, the named object). No marker move, no RH claim. Machine-checked: [\[verification/v891_moebius_firewall_kills.py\]](#). (MEASURED) (the three firewall batteries — honest kills, recorded with mechanisms) + **[O]** (the deep-core remnant — the named residue)

The closure architecture of the wall (PRIME.PORT.RELCONG.01; PRIME.PORT.PIVOTFACTOR.01; PRIME.PORT.EULER.ROUCHE.01; PRIME.PORT.DEEPCORE.SCHUR.01). Four probes (16/16 + 15/15 + 14/14 + 16/16; RELCONG-MEASURED, PIVOTFACTOR-MEASURED, ROUCHE-MEASURED, DEEPCORESCHUR-MEASURED; embedded byte-exact; SPEC v2 amendments on record). The inheritance step exact and complete: $A_{h+1} = A_h^{1/2}(I + H_h)A_h^{1/2}$ with H_h hermitian, so PD inheritance *is* $\eta_h = 1 + \lambda_{\min}(H_h) > 0$ (Sylvester) — and η is *non-decaying* (min 0.0050, slope +0.108 while τ collapses at -2.74 ; $\rho(W^{-1}\Delta C)$ exposed as a non-normal statistic; smooth CONE-EXITED 28/28); all 12 LDL flag quotients positive on 31/31 truth steps (soft-flag min 2.06×10^{-14} , sign-decidable at $6.4 \times 10^9 \times$ the noise floor; smooth violates at the *bulk* flags); the two-sided matrix-Rouché route honestly dead ($M \geq 1$ on 22/31 incl. off-cap — the contour-norm shape is the wrong shape; the argument-principle machinery itself verifies exactly); and the wall *is* the fixed 8×8 Schur core ($\lambda_{\min}(S) w_{\text{core}}/\tau = 1 \pm 8.4 \times 10^{-8}$, $w_{\text{core}} \geq 0.999937$ on 41 rungs; the absolute exterior margin shrinks $h^{-2.865}$ while R/τ is trendless at 210–2200). No marker move, no RH claim. Machine-checked: [\[verification/v892_closure_architecture.py\]](#). **[E]** (the congruence, pivot-factorization and Haynsworth identities — exact) + (MEASURED) (the margin ladders, flag censuses and the Rouché kill) + **[O]** (the τ -sign inheritance — the named open statement)

The margin sources and the bounded-margin skeleton (PRIME.PORT.ETASOURCE.01; PRIME.PORT.RELFLAG.01). Two probes (20/20+18/18; ETASOURCE-MEASURED (SCALE-MATCHED), RELFLAG-MEASURED; embedded byte-exact; SPEC v2 amendments on record). The η margin is SCALE-MATCHED: in the dangerous direction the increment and the operator collapse *together* (slopes $-3.716/-3.456$, residual correlation 0.974, 94% shared variance) — the non-decay explained, only the $O(1)$ scatter of the ratio open; the soft pivot obeys $d_{12} = 1/(A^{-1})_{12,12}$ exactly with $r_{12} = (\tau'/\tau)(c'/c)$ warded at 2.1×10^{-16} , the conditioning ratio trendless (the kz-21 outlier a coordinate artifact per the round-53 sandbox, corrected spread $124 \rightarrow 15$ — the soft flag is τ -tied); $\lambda_{\min}(R)/\tau$ trendless with $c_R = 210$; COMPRESSIONS-DISTINCT (the port bulk floor absolute, the core exterior τ -tied). The printed skeleton: base certified + $R \geq 210\tau + \text{core} \Leftrightarrow \tau$ at seven digits + $\eta > 0$ — *one* unconditionally open statement, the τ -sign inheritance in bounded-margin form ($c, c'/c, c_R, \eta$ — all $O(1)$). No marker move, no RH claim. Machine-checked: [\[verification/v893_relative_margins.py\]](#). **[E]** (the soft-pivot algebra and factorization wards — exact) + (MEASURED) (the source regressions and relative-law ladders) + **[O]** (the bounded-margin statement — the program's open kernel)

The conditional diagonal contract made concrete (PRIME.CASE.PAIRCORR.CONTRACT.01 [O]). Three probes (11/11 + 13/13 + 12/12; PAIRCORR-EXTRACTED (KERNEL-BANDLIMITED), ENDPOINT-MEASURED (ENDPOINT-PARTIAL), INNERLINEAR-MEASURED (INNER-EMPTY); embedded byte-exact; the route stays conditional per v889). The weighted prime-pair correlation functional whose nonnegativity implies $T_h \leq 1$ on the critical zone is extracted exactly (regrouping ward 4.5×10^{-15}); the kernel $K_{h,m}$ is band-limited; the LaTeX contract statement is frozen in-probe; all 79 finite deficit margins positive; the endpoint bracket: the global linear collapse fails (142/227) but the deep small- a cells pass with monotone margins; the inner zone: the frozen absolute rule gives INNER-

EMPTY, the disclosed scale-normalized diagnostic is flat (slope -0.052), and the genuinely hard band is *non-shrinking* ($\sim 20\%$ of aliases, $38\text{--}56\%$ of the mass) with *a*-graded stability on a mid shell — the condition localized, not removed. *Norm-square note (round CXV)*: the kernel's negativity is one top-edge tent, killed exactly by the periodic full-weight fold — the contract is a norm square in the frequency weights ([[verification/v899_christoffel_normsquare.py](#)]); the hypothesis itself stays conditional. No marker move, no RH claim. Machine-checked: [[verification/v894_diagonal_refinement.py](#)]. [E] (the kernel-regrouping and bracket identities — exact) + (MEASURED) (the endpoint and inner-zone censuses) + [O] (the band's weighted pair inequality — the demand)

The collectivity of the arithmetic (PRIME.PORT.FACTORAVOID.01; PRIME.PORT.DEEPCORE.01). Two probes ($18/18 + 12/12$; FACTORAVOID-MEASURED (AVOIDANCE-STRUCTURAL), DEEPCORE-MEASURED; embedded byte-exact; SPEC v2/v3 amendments on record). The norm-bound shape does not exist on truth ($\rho \geq 1$ on $17/31$ steps, always via the harmless side); the true law is *one-sided*: $\max(-\min \mu) = 0.9950 < 1$ on all 31 steps — PD inheritance itself; the geometry/atom split is exactly degenerate (no separable atom channel — the increment is the collective window re-test); per-prime leave-one-out non-decompositional (leverage to $987\times$ — a census, not a decomposition); and the deep core *is* the port core: the fixed even aliases $\{2, \dots, 16\}$ at the Bessel coordinates $a_m = \pi^2 m^2$ (0.1% ; knee $k^* = 10$), with *all four* surgeries killing the coherence — the signal is the entire multiplicative von Mangoldt comb; no smaller frozen object exists. No marker move, no RH claim. Machine-checked: [[verification/v895_collective_comb.py](#)]. [E] (the factorization and split wards — exact) + (MEASURED) (the one-sided law, the leverage census and the surgery kills)

The certified interval ladder (PRIME.PORT.BALLLADDER.01, delivered). Two probes (BALLHEAD-PROVEN, BALLLADDER-COMPLETE $10/10$, 3960 s; source embedded byte-exact with SHA wards; the 15 tier-1 + 3 tier-2 subset re-certified verbatim in-suite, the full census frozen). $\sigma_h > 0$ with *rigorous* mpmath.iv interval shifts on all 42 reachable rungs: 15 exact-rational integer Bareiss/Sylvester ($h \leq 300$) + 27 validated-precision Cholesky dps $120/200$ (floors down to 5.2×10^{-6} , pivot-to-bound ratios $\sim 10^{115}$); the node-enclosure lemma at radius 10^{-90} ; the rigorous shift $2h \text{ rad}_{\max}$; the Epstein control refused at pivot 10 — **the informal ε_c error model of v884/v887 is retired from the ladder**. No marker move, no RH claim (the asymptotic tail is untouched). Machine-checked: [[verification/v897_certified_interval_ladder.py](#)]. [E] (the interval-rigorous Sylvester certificates) + [O] (the Lean composition and the asymptotic tail — the named remainder)

The Christoffel pivot identity and the norm-square contract (PRIME.PORT.CHRISTOFFEL.RATIO.01; PRIME.CASE.KERNEL.SOS.01; PRIME.CASE.EDGEDEFECT.01). Three probes ($19/19 + 15/15 + 19/19$; CHRISTRATIO-MEASURED (WINNER-CHRISTOFFEL), KERNELSOS-MEASURED (INDEX-LARGE; RMIN=1; NOT-ABSORBED), EDGEDEFECT-MEASURED (NORMSQUARE-ACHIEVED; KILL=PERIODIC; CHAIN=CARRIED); embedded byte-exact; SPEC v2 on record). $1/d_{12} = 1 + v_* K_\sigma(y_*)$ exact (independent route 2.0×10^{-11}); the honesty fence $\lambda_{\min}(I - G) = \tau$ exact — a coordinate change, not an independent positivity source; c'/c SENS $[0.223, 5.258]$; the pair kernel's entire negative content is one top-edge tent (weights $W_{f,m} \geq 0$ exact), killed exactly by the periodic full-weight fold (negative index 0; $79/79$ modified margins positive; boundary term carried, max 0.21) — the conditional contract is a norm square in the frequency weights; the hypothesis stays conditional. No marker move, no RH claim. Machine-checked: [[verification/v899_christoffel_normsquare.py](#)]. [E] (the pivot, fold and repartition identities — exact) + (MEASURED) (the ratio and margin censuses) + [O] (the band inequality — the demand)

The normalized core update anatomy (PRIME.PORT.NORMALIZED.CORE.01; PRIME.PORT.GRAPH.REGION.01). Two probes ($20/20 + 23/23$; NORMCORE-MEASURED (UPDATE-EXACT(UDIM=2)), GRAPHREGION-MEASURED (COUPLING-FREE / GRAPH-REGION-OPEN / SHADOW-LAWLESS); embedded byte-exact). The normalized deep core obeys $X' = c(X + U)$ exactly (8.3×10^{-16}) with a two-dimensional input ($c = \tau/\tau' +$ one matrix mode at 97.5% energy); the honest negatives registered as boundary conditions: no linear coupling law (both R^2 below the shuffle null), the rank-1 truncation drops the positivity-carrying off-mode, naive invariant sets refused — any region

construction must keep the exact $X + U$, truncating no mode. No marker move, no RH claim. Machine-checked: [\[verification/v900_core_update_anatomy.py\]](#). [E] (the update and telescoping identities — exact) + (MEASURED) (the coupling nulls and region sweeps — the honest negatives)

The wall in tangent-Schur coordinates (PRIME.PORT.TANGENT.SCHUR.01; PRIME.PORT.BFLOOR.01; PRIME.PORT.SIGNFREE.NORMALIZATION.01). Three probes (26/26 + 24/24 + 18/18; TANGENTSCHUR-MEASURED (SAFEBLOCK(MINB=0.679)), BFLOOR-MEASURED (BFLOOR-SCREEN-PASS(SLOPE=-0.247) / CERTFLOOR-DEAD), SIGNFREE-MEASURED (DECIRC-ACHIEVED); embedded byte-exact). The exact source-only split: with the co-block B PD, the wall update is $PD \iff n - q > 0$ (two scalars, no τ_{h+1} , no forward sign); the co-block floor 0.679 is $O(1)$ ladder-wide while τ falls by factor 552 (the first substantive τ -screen pass, slope -0.247 ; the raw co-block scales like τ , said honestly); all four classical certified bounds stay negative everywhere (CERTFLOOR-DEAD — the floor is measured, never certified); $\ell = \det(S)^{1/8}$ de-circularizes the update coefficient — circularity removed, positivity *not* gained. No marker move, no RH claim. Machine-checked: [\[verification/v901_tangent_schur_bfloor.py\]](#). [E] (the split, determinant and source-side identities — exact) + (MEASURED) (the floor, the screen and the honest certification negative)

The wall relocation map (PRIME.CASE.EDGE.CHRISTOFFEL.01; PRIME.PORT.GRAM.COMPLETION.01; PRIME.PORT.RADAU.WEIGHT.01). Two probes (22/22 + 23/23; EDGECHRISTOFFEL-MEASURED (REWRITE-EXACT / RATIO-BELOW-ONE), GRAMRADAU-MEASURED (M0-IDENTITY-EXACT / GRAM-COMPLETION-FAILS / RADAU-EXACT); embedded byte-exact; typed explicitly a relocation/mechanism map, *not* progress). The pivot splits exactly into $1/d_{12} = 1 + \sum WQ^2 - \beta$ with $W > 0$ and $\beta \geq 0$; the ratio $r < 1$ on every rung but $1 - r$ tracks τ (slope $+1.008$) — the uniform $q < 1$ target is the wall's own PD premise quantified; $M_0 = I - H$ is the moment matrix of the signed comb measure, and the $W \geq 0$ Gram completion fails on every rung at the $x = +1$ edge; the Radau weight at the classical node is the Christoffel function (a pure μ_+ object) and the P2 pivot is *not* a Radau weight. No marker move, no RH claim. Machine-checked: [\[verification/v902_wall_relocation_map.py\]](#). [E] (the rewrite, moment-matrix and Radau identities — exact) + (MEASURED) (the relocation slopes and the edge obstruction census)

The 12-bit pivot health word (PRIME.ARITH.HEALTHCODE12.01). One probe (18/18; HEALTHCODE12-MEASURED / DIAGNOSTIC-ONLY / TRUEWORD-ALLPLUS / SOFTPIVOT-12(0/37) / V897-PIVOT10-REPRODUCED / SMOOTHCLAIM-REFUTED; embedded byte-exact). The sign word of the 12 leading LDL pivots of the v899 12-window compression, typed a pure *diagnostic* with zero RH content in either direction: the true word is all-(+) on 37/37 (the certified Sylvester census repackaged — no new content); three plan claims corrected (attribution, softness seat, smooth signature); the v897 Epstein pivot-10 refusal reproduced byte-exact; the seeded syndrome table distinguishes four adversarial fingerprints — a classifier of manipulated combs, a tool, not a target. No marker move, no RH claim. Machine-checked: [\[verification/v904_healthcode12_diagnostic.py\]](#). (MEASURED) (a diagnostic census and syndrome table — zero RH content by construction)

The certified B-half surface floor (PRIME.PORT.BFLOOR.PG.01; PRIME.PORT.BFLOOR.PG.IVAL.01). Two probes (21/21 + 25/25; BFLOORPG-MEASURED (CERTIFIED-SURFACE-FLOOR-ACHIEVED(MIN $c_B=0.5914$)), BFLOORPGIVAL-MEASURED (IVAL-SURFACE-FLOOR-ACHIEVED(MIN $c_B=0.5523$, 0 REFUSED / 0 FAILED / 0 SKIPPED))); embedded byte-exact; SPEC v3 on record). The chain $B \succeq \frac{1}{2}P_G + c_{\text{dom}}I$ and $P_G \succeq c_G I$, every inequality decided by exact-rational LDL (the v897 certificate class) on all 39/39 reachable steps — and, via rigorous outward interval enclosures of the full pipeline with an Ogita–Rump high-accuracy tier, over the *ideal* source objects (fail-closed; the smooth world refused by the identical exact machine); P_G is Gershgorin-positive — the single non-classical link is the dominance decision; after three dead certificate rounds the missing piece was the certificate class, not a new congruence. Honest scope: a surface statement — h -uniformity beyond $h \sim 900$ open, the $n > q$ half untouched and RH-hard. No marker move, no RH claim. Machine-checked: [\[verification/v905_bfloor_ideal_certificate.py\]](#). [E] (the exact-rational LDL decisions and interval enclosures) + (MEASURED) (the floor censuses and the τ -screens) + [O] (all h beyond the surface; the $n > q$ half)

The tail mechanism map (PRIME.PORT.TAILESIGN.01/.02; PRIME.PORT.PG.SCHUR.01; PRIME.PORT.TAIL.ABEL.01; PRIME.PORT.TAIL.SEGSPLIT.01; PRIME.PORT.TAIL.OSCPAIR.01). Six probes (14/14 + 10/10 + 20/20 + 22/22 + 24/24 + 22/22; TAILESIGN-MEASURED, TAILREPAIR-MEASURED, PGSCHUR-MEASURED, TAILABEL-MEASURED, SEGSPLIT-MEASURED, OSCPAIR-MEASURED; embedded byte-exact; typed explicitly mechanism/negative cartography, *not* progress). Five dead routes with named seats: the tail sign is net-only (pointwise dead everywhere); the pointwise repair grows with the window ($X^{0.89}$); the directional Löwner route loses two orders of magnitude (floor-vs-inverse mechanism); the cumulative/Abel route is exact but its envelope leaves the gap law $e^{+1.744\alpha}$ (the hole is the oscillation); the segment split is costlier than the global route (the anchor price; the named missing object: a difference envelope on short deep windows, Brun–Titchmarsh/Selberg class). Two structural positives: HEADFLOOR-O1 (the whole h -decay lives in the tail; the open statement is one-sided between two $O(1)$ objects) and the 12-bin reduction (~ 12 low-frequency windowed ψ -fluctuation coefficients carry the statement; the reduced margin carries the full decay — dimension reduced, difficulty not). No marker move, no RH claim. Machine-checked: [verification/v906_tail_cartography.py]. [E] (the transport, segment and Löwner identities — exact) + (MEASURED) (the five registered negatives and the two structural positives)

The registered half-gap target (PRIME.PORT.HALFGAP.01; PRIME.PORT.DEEP.HOLDOUT.01). Two probes (17/17 + 14/14; HALFGAP-REGISTERED (REG-FROZEN(1/2, NO-ADJUST)), DEEPHOLDOUT-SCORED (HALFGAP-HOLDOUT-PASS(28/28, MIN MARGIN +0.2232)); embedded byte-exact). A falsification instrument, explicitly *not* evidence: $n_h - q_h \geq \frac{1}{2}\mu_1(h)$ registered on the 67-rung surface (constant exactly $\frac{1}{2}$ frozen, NO-ADJUST clause part of the object, registry sha ae292e55, min margin $+2.48 \times 10^{-3}$, four candidate origins of the $\frac{1}{2}$ typed open); the first genuine blind holdout passes on 28 new deeper rungs (h to 2854, bit-exact table fidelity, $\sim 90\times$ margin headroom, no depth erosion, the honest cut-ladder drift disclosed; B -floor/ P_G persist at declared float level; the margin law -1.925 continues over 95 rungs); controls discriminate 3/3. A pass is survival of a falsification attempt, never evidence. No marker move, no RH claim. Machine-checked: [verification/v907_halfgap_registered_target.py]. (REGISTERED + MEASURED) (a frozen target inequality and its blind-holdout score) + [O] (the algebraic origin of the $\frac{1}{2}$ — the demand)

The finite wall closure (PRIME.WALL.FINITE_CLOSURE.01). One module (28/28; reduced-subset re-verification with a committed 7,000-ordinate verified-zero cache, warded in-run; the full census cited with its spec hashes). On the deployed finite ladder the composed census $B \wedge W1 \wedge W2$ holds on 39/39 matched surface + 8/8 deep rungs from cited inputs: the B -half interval floor ($\min c_B = 0.5523$, v905), the $W1$ monotone composition (the old $+8..+9$ dex composition gaps dissolved into one exact measure inequality) with the verified-zero supply at the $j = 16$ seat (39/39 at $N_Z = 7000$, composed 67/67 with the cited deep 28/28), and the $W2$ recomposed certificate (67/67 + 8/8 with the 2×10^7 -ordinate certified cache). The promoted gate pins only the reduced subset (meta-audit CCCXXXVI): a false cited full census would not fail the module — the 39/39 + 8/8 census rests on the frozen experiments runs and their spec hashes, not on the v909 gate. Language frozen: $W1$ and $W2$ are *algorithmically independent evaluations of the same localized Weil form* — a strong mutual crosscheck, not two independent proofs; positivity is certified on a finite family of Galerkin sections along the *measured* critical direction (direction-conditional); the zeros are EXTERNAL-CITED (Odlyzko, LMFDB/Platt, Platt–Trudgian 2021, Rosser 1941, Büthe 2018). A finite verified-zero sum can never prove RH. No marker move, no RH claim. Machine-checked: [verification/v909_finite_wall_closure.py]. [E] (the split, dual and Loewner identities — exact) + (MEASURED) (the censuses, floors and heart wards, finite surface, cited inputs) + [O] (all h beyond the ladder; the all-direction object)

The transfer law (PRIME.WALL.FINITE_ZERO_TRANSFER.01). One module (10/10; shallow end re-verified, full ladder cited, SPEC 40a7b5c3). The zero-supply economics of the finite closure: $T_{\text{req}}(h) \sim h^{2.8}$ ($\log_{10} T_{\text{req}} = -3.045 + 1.228 \ln h$, $R^2 = 0.882$) and the ratio to the window's own spectral reach π/D_h grows ($+0.897$ dex/ $\ln h$): the verdict is EXTERNAL-BATTERY / W-UNBOUNDED-PER-RUNG — the finite engine does not scale by buying zeros. The parametrized

transfer law: $\text{ZerosCertified}(T) \wedge \text{TailEnvelope}(T) \Rightarrow M_h \succ 0$ for all deployed $h \leq H(T)$, with $H(\gamma_{7000}/\gamma_{2M}/\gamma_{2 \cdot 10^7}) = 254/1256/2806$; $H(T)$ is the measuring rod any analytic per-window bound has to beat. The promoted gate pins only the shallow subset (meta-audit CCCXXXVI): $H(\gamma_{2M}/\gamma_{2 \cdot 10^7})$ and the full-ladder fits are cited, not pinned by the $v910$ gate. Per-rung, deployed ladder, measured critical direction; $H(T)$ says nothing about undeployed h ; the extrapolation is a fit, not a theorem. No marker move, no RH claim. Machine-checked: [\[verification/v910_finite_zero_transfer.py\]](#). (MEASURED) (the supply curves, censuses and laws) + **[O]** (the analytic per-window bound — the named demand)

The form-convergence theorem (PRIME.FORM.CONVERGENCE.THEOREM.01). One module (35/35, verdict FORMCONV-PROVEN). The extraction chain’s per-element convergence premise — until now typed MEASURED (the corpus rates $-1.58..-1.84$ per level of $v848$) — is proven *unconditionally* for the deployed dyadic cellwise-affine family, with an explicit rate and explicit constants: $|Q_D(f) - Q_W(f)| = O(D^2 \log(1/D)) = O(2^{-2j} j)$, with $\Theta_0 = 3 \log 2 + \pi/2 + \gamma + \log \pi$ and, for continuous f , log coefficient exactly $7/24$. Three exact steps carry it: the deployed lag vector *is* the capped Weil functional on the even tent, so the finite form equals $W_C[\widetilde{K}_D]$ exactly; midpoint exactness on cellwise quadratics makes the nodal defect exactly $-(D^2/12) G(dD)$ (zero deviation in exact rationals over 1474 lag identities and 780 interior points); the faithful cap $C \geq b_K + D$ turns the error into W_C of *one* explicit function, bounded by elementary majorants per layer. Sharpness is measured against a closed-form leading term (ratio $0.575..1.066$, drifting to 1 through $j = 18$), so the law is genuine and not a loose envelope. The only cited arithmetic input is Rosser–Schoenfeld $\psi(x) < 1.03883x$, consumed *only* for support uniformity and independently sieve-verified to 10^7 ; no zero-free region, no PNT, no zeta zeros enter. *Audit correction* (a correction of a wrong cited statement, not a downgrade): the chain’s cited C^0 -continuity of Q_W at fixed support is *false* in the pure sup norm — control C5 exhibits an explicit even Lipschitz family with $\|e_n\|_\infty \rightarrow 0$ and $|A[e_n]|$ growing linearly — and the true hypothesis is uniform convergence *plus* an equi-Lipschitz (Dini) condition at the origin, supplied by the admissible even compactly supported BV class. Pinning (meta-audit CCCXXXVI): the W1 measure dictionary, Weil’s explicit formula and criterion, the admissible class with its density leg, the all- x Rosser–Schoenfeld statement and the universal quantifier itself are *cited*, not pinned by these gates. DELTA-A: `CofinalEnvelope.lean` states the envelope premise and derives the Lean convergence hypothesis from it, so that hypothesis is the instantiated envelope rather than an opaque assumption — but the envelope is not discharged inside the kernel. This closes the convergence edge only: the cofinal positivity inequality is untouched and RH-hard. No marker move, no RH claim. Machine-checked: [\[verification/v912_form_convergence_theorem.py\]](#). **[E]** (the defect lemma, the tent and master identities, the class constants — exact in $\mathbb{Q}$) + (MEASURED) (the envelope, sharpness and uniformity readings on the declared grid) + **[C]** (the W1 dictionary, Weil’s formula and criterion, the admissible class and the density leg, Rosser–Schoenfeld for all x) + **[O]** (the cofinal positivity inequality — untouched)

The signed-and-alignment localization — a no-go/typing row, not progress (PRIME.NOGO.SIGNED.ONLY.01). One module (24/24, verdict NOGO-CORE-VERIFIED). It supplies no positivity, no interval and no certificate: it prices *argument classes*. Any argument closing the deployed budget inequality must be *signed* — it must orient a quantity that is odd under the comb sign flip — and *alignment-carrying* — it must relate the position of the prime atoms to the spectral directions of K ; in particular it can be neither a magnitude bound on $\psi(x) - x$ nor a natural-grammar identity valid in every arithmetic world. The exact core: $\|K'_D\|_1 = 4$ independent of D (the conversion constant of a magnitude hypothesis does not get cheap as the mesh refines) against an $O(1)$ negative supply recomputed by two independent routes, so Littlewood’s Ω -theorem empties the magnitude class (floor/slack 214.7 on the module’s own conservative slack, 1527.1 on the deployed one); the exact three-term split is invariant under every congruence with an *odd* carrying term, so no unsigned hull can bound it below; Selberg’s symmetry formula is a formal identity, hence neutral; and the Beurling–Nyman/Baez–Duarte target has no N -uniform Gram floor (cap 0.420220 against the needed $c_B = 0.5523$) with an explicit non-implying family. Ten classes are proven empty (E1–E10), five are merely unexplored (U1–U5) and five clauses are named open (O1–O5); the statement

is finite-rung ($h = 184/388/839$ with the ladder to 12632) and makes no all- h claim. It does *not* say that the Riemann Hypothesis is unprovable, that the wall route fails, or that no proof exists, and the counter-evidence is carried unsmoothed: the certified reads are positive at all nine depths (deepest $2.79579794131272506 \times 10^{-15}$ at $h = 12632$), the normalised decay flattens with depth and one re-derived step is positive, so the drift is not monotone. Pinning: the identities, split algebra, Selberg neutrality, Beurling–Nyman witnesses, supply recomputation, own sieve, frame rebuild with predicted h and the reproduced probe SPEC-SHA are pinned; the deployed ladder and its certified reads, the deployed entry slack, Littlewood’s theorem itself, the float64 slack premise of the matrix stage, the deployed budget shape, the four premises of the reverse implication and the counter-evidence corpus are cited. Closes no gate, narrows no gate, moves no marker, and must not be counted as progress or as evidence for or against RH. Machine-checked: [verification/v913_signed_alignment_localization.py]. [E] (the kernel identities, the split algebra and its parity, Selberg neutrality, the Beurling–Nyman witnesses — exact in $\mathbb{Q}$) + [C] (Littlewood’s Ω -theorem, the deployed ladder and entry slack, the budget shape) + [O] (the residual requirement itself — localized, not closed)

The Pascal-region theorem — a certified-finite result, not RH evidence (PRIME.PASCAL.REGION.THEOREM.01). One module (18/18, verdict PASCAL-REGION-THEOREM). At the safe point $a = 256$, with $y_\rho = a/(a - (\rho - 1/2)^2)$, the Pascal field satisfies $C_{n,k}(256) = \sum_{\mathfrak{P}_\rho > 0} y_\rho^{n+1} (1 - y_\rho)^k > 0$ for every $n \geq 0$ and every integer $0 \leq k \leq 7,444,682,106,464,286,365,865$ ($\sim 7.44 \times 10^{21}$), proven from cited external inputs alone: Platt–Trudgian 2021 Thm 1 ($T = 3,000,175,332,800$), Hasanalizade–Shen–Wong JNT 235 (2022) Cor. 1.2 ($|N(t) - M(t)| \leq 0.1038 \log t + 0.2573 \log \log t + 9.3675$, $t \geq e$; the attribution flag of a later audit resolved from the paper — Cor. 1.2 *is* the $N(t)$ bound used, Cor. 1.4 the companion $S(t)$ bound, not used), Rosser 1941 Thm 19 and the classical γ_1 isolation. The complete four-region base partition ($k \leq 10^{19}$) and the quadratic verification-height law $k_{\text{front}}(T) = (\lambda_\infty + O(1/\log T)) T^2/(a - 1/2)$, $\lambda_\infty = 0.226987054723979955$, are recomputed at every suite run; the 33-cell run-of-record frontier partition is pinned with a frozen six-cell full-packet recompute including the worst cell (endpoint ratio 1.000001535385559; the next 2×10^{-6} step fails — mechanism-exact). Honest typing: verification-powered and *form-local* — zero-location content below $\gamma_1 = 14.13$, nothing about screw sections or Weyl disks, the $k \rightarrow \infty$ quantifier untouched; no wall positivity, no zero table, no zeta evaluator. Not evidence for or against RH. Machine-checked: [verification/v914_pascal_region_theorem.py]. [E] (the certified finite theorem from the cited inputs; the recomputed partition and law) + [C] (the cited Platt–Trudgian/HSW22/Rosser inputs; the pinned run-of-record cells) + [O] (the $k \rightarrow \infty$ quantifier — untouched)

The certified Euler–Pick floors $N = 1..4$ — a reach-capped falsification channel (PRIME.EULERPICK.CERTIFIED.FLOORS.01). One module (15/15). Outward-rounded interval positivity certificates for the first four rungs of the Euler–Pick ladder ($P(\sigma) = \xi'/\xi(1/2 + \sigma)$, $\sigma_j = 1 + 1/j$; RH iff $\mathcal{P}_N \succeq 0$ for all N , forward direction exact): the $N \leq 3$ floors are recomputed in-run at caps 4×10^6 and 1.6×10^7 (own sieve; Büthe 2018, Rosser–Schoenfeld 1962 and Nair 1982 all warded against own data; the round-95 record reproduced, $\log_3 = 2.3643695 \times 10^{-10}$), and the cap- 10^{13} intervals — $N = 4$: $[8.278338 \times 10^{-15}, 1.3840906 \times 10^{-14}]$, margin 0.749, $\pi(10^{13}) = 346,065,536,839$ reproduced exactly — are pinned from the run-of-record 45-minute compiled sieve with the split disclosed; the summation-error model is re-derived rigorously without the sieve, the Nair far-floor necessity and the corrected budget $X_{\text{req}}(4) = 10^{11.52}$ are recomputed, and $N = 5$ is knowledge-walled (the beyond- 10^{19} floor exceeds λ_5 by 4.7×10^5 at any cap). Honest typing: the channel is *disproof-sound* (a certified negative rung would falsify RH via the forward direction alone) but *reach-capped* at $\gamma \sim 5\text{--}8$ (recomputed detection subset), far below Platt–Trudgian’s 3.0×10^{12} — zero live falsification power in the classically certified range; “open and empty” is a theorem given the cited inputs. The channel stays open and empty. Not evidence for or against RH. Machine-checked: [verification/v915_eulerpick_certified_floors.py]. [E] (the recomputed certified floors and wards; the re-derived error model) + [C] (the cited Büthe/RS/Nair bounds; the pinned 10^{13} run-of-record) + [O] (all- N positivity — the wall itself, untouched)

The certified Epstein Weil-positivity violation — a validated falsifier instrument, not RH evidence (PRIME.KR4.EPSTEIN.COLLAPSE.01). One module (20/20, verdict EPSTEIN-WEIL-VIOLATION-CERTIFIED). There is an explicit sha-pinned unit test vector (len 1038, sha b01436d53d2cbbbee, reproduced in-run) whose tent autocorrelation $\psi_x = h_x * \tilde{h}_x \geq 0$ pairs *negatively* with the source data $-g_Q''$ of $Q = x^2 + 5y^2$ (discriminant -20 , class number 2): $V = x^T T x = -1.9697 \times 10^{-2}$, error budget $\leq 4.3 \times 10^{-68}$, two-precision (dps 80/110) agreement 9.8×10^{-79} — windowed Weil positivity for ξ_Q *fails* at $t \leq 3.114$, built purely from $r_Q(n)$ lattice counts (exact sieve with the exact ward $r_Q = 1 * \chi_{-20} + \chi_{-4} * \chi_5$; log-derivative recursion, no Euler product exists; zero cache unused, witness constants firewalled out of every builder). The controls carry the fires-iff-fires content: true zeta *and* the conductor-matched null $\zeta_K = \zeta_{L-20}$ complete positivity through $L = 8.0$ (conductor alone does not collapse), while the Q world dies at $t_{\text{death}} = 2.988$ (recomputed eigenvalue crossing $k^\dagger = 998$; mesh and dps stable), and the certificate vector reads *positive* on the matched null. The three pre-declared falsified predictions travel verbatim: attribution is COLLECTIVE (witness removal moves the death by only 0.018; removing *all four* located off-line pairs survives to 4.428), the death law misses by $0.505 > 0.5$, and the frozen census is falsified — four off-line pairs live below height 45 and the round-117 witness was never γ -minimal (the 15.6682 *driver* carries $26\times$ its excess). Honest typing: the value is CERT-NUM (source-side, unconditional-numeric); the step “ $V < 0 \Rightarrow$ off-line zero” rides the classical Weil/Guinand explicit formula for ξ_Q (COND-CLASSICAL, cited); the zeros themselves are classical (Potter–Titchmarsh 1935; Davenport–Heilbronn 1936) — the promoted claim is the certified explicit finite certificate *from source data*, not the existence: known falsehood, new instrument. The min-cut is unchanged (flows 4/4; the falsifier has no path into RH): a detector is a falsifier, not a prover — for zeta the same instrument at any finite window proves nothing. Not evidence for or against RH. Machine-checked: [verification/v916_epstein_weil_violation.py]. [E] (the recomputed sieve, wards, deaths and the full certified quadratic form) + [C] (the pinned $L = 8.0$ completions, census and law; the cited explicit-formula step) + [O] (zeta — untouched in either direction)

The certified localized rate detection of the driver — given-audit grade, carried verbatim (PRIME.KR4.DRIVER.CERT.01). One module (13/13). The round-123 driver zero $\rho = 0.9329696975 + 15.6682495313i$ of ξ_Q , source-located from the Λ_Q sieve ($\Delta\gamma = 6.6 \times 10^{-5}$ against the locator’s own 2×10^{-2} box, then audit-polished, typed WARD), fires in the band-peeled rate channel at depth $m^* = 14$ with certified LB = 1.000137 > 1 , *localized* from $m_{\text{loc}}^* = 15$: peeling the resonant on-line band $\gamma \in (7.90, 31.40)$ (winding-count-complete, every peel $|\xi_Q|$ -verified — phantom peel doubly excluded) caps the bulk at $v_{\text{edge}} = 0.639$ and collapses the unpeeled depth price $m_2 = \ln 2 \gamma^2 / \delta^2 = 908$ by $\times 65$; the new exact algebra is recomputed symbolically and at dps 200 at every suite run ($v^* = 1 + \varepsilon$ *exactly real* at the matched pin $a^* = \delta^2 + \gamma^2 = 245.6815$, weight exactly 1, the a^2/z weight-sum rigidity); LB converges to v^* to six digits by $m = 25$, certified depth 32, Err $\approx 2.1 \times 10^{-12}$, meas $\leq$ cond. The quantified detection-cost law travels with it: $m^* \approx \ln(B_{\text{band}}/\varepsilon)/\ln(1/v_{\text{edge}})$ with sieve price polynomial in $1/\varepsilon$ via the band (measured 3.19 certified depths per unit $\ln N$; the executed route needed only $N = 2 \times 10^5$ atoms where the direct brute costs $N \sim 10^{124}$). The grade is carried verbatim and never upgraded: CERT-GIVEN-AUDIT (rigorous Cauchy enclosure *given* the incomplete-gamma audit comparator plus the *declared* tail/peel models) and DISGUISE-ADJACENT (the deep read is an Euler-computable truncated windowed Weil transform; the Krein carrier cannot exist on Q past the collapse). The honest caveat is carried: the pre-declared G11 gate (locator relocates 4/4) *failed* — the weak round-117 witness (excess 2.9×10^{-5}) sits below the locator’s measured threshold at $N = 2 \times 10^5$; the locator is a 3/4 measured instrument and no 4/4 claim is promoted. The min-cut is unchanged (flows 4/4; the rate certificate has no path into RH): a certified detector is a falsifier, not a prover. Not evidence for or against RH. Machine-checked: [verification/v917_driver_rate_certification.py]. [C] (the given-audit certification with declared tail/peel models; the pinned depth table, band census, locator and controls) + [E] (the exact matched-pin algebra, window formula and Pascal-diagonal dictionary, sympy-exact) + [O] (zeta — untouched in either direction)

Theorem R — the double-limit reduction of the prime-front proof arc (PRIME.

DOUBLELIMIT.REDUCTION.THEOREM.01). One module (13/13). The load-bearing reduction of the rounds-128–151 arc, proven with elementary inputs: L1 (trace convergence to the source-side target, absolutely convergent exactly for $a > 1/4$) + WPD ($d_1 > 0$, $|d_k| \leq C 4^{1-k} d_1$) $\Rightarrow$ (H-conv) on the full Euler interval + (H-trace) with the *explicit rate* $\max(1, C)(-4 \log(1 - t/4)) d_1$, via the exact series identity $\log(R_{\text{fin}}/R_a)(t) = \sum_k t^k d_k/k$; with the cited round-122 NF-closure theorem the exact reduction reads $\text{RH} \Leftarrow [\text{NF-closure}] + [\text{Theorem R}] + \{\text{L1, WPD}\}$ on dense a . Lemmas travel with it: N (necessity; Vitali + Cauchy, cited), S (sub-multiset defect $\Rightarrow$ PD exactly, sharp at the band edge; sandwich pinned $0.121737 \leq 0.124501 \leq 0.289309$), X (moment transfer is *not* free: $d_1 = 0$ yet $d_2 = -1/128$ exactly), and the exact $C_{0k} \leftrightarrow$ jet dictionary. The honest typing is carried verbatim: WPD's k -tail *is* window positivity (the exact witness $k^*(B) = \lceil \log(2B)/\log(4w^*) \rceil = 29959/76013/145094$ from $4w^* = 10001/10000$ exact, recomputed in-run) and L1 stays obstructed at the node-law wall — proven is the *reduction* and the *coordinate*, not the convergence. Source probe re-run green as typed at promotion (28/28, SPEC 0c77ef7c); independently re-derived in Bughunt III. Not evidence for or against RH. Machine-checked: [verification/v918_doublelimit_reduction_theorem.py]. [E] (the exact algebra, dictionary, adversarial instance and k^* witness, recomputed in-run) + [O] (L1/WPD — open, typed, untouched in either direction)

The secular identity and the Guinand–Weil pinning (PRIME.SECULAR.GW.PINNING.01). One module (11/11). Layer 1, secular-exact, recomputed in-run on an own exact-rational instance (Fractions, $K = 6$, dim 11, 13 interpolation points $>$ degree — a polynomial identity, sympy-free): $\det(M_\eta - z) = -z C(z^2)/A_0$ *exactly* — the operator nodes *are* the census-polynomial zeros, the node count is *exactly* $K - 1$; the η -degeneration is the boundary decay $A_0 \rightarrow 0$ (the nodes, not the matrix, are the honest object). Layer 2, GW-pinning, certified per rung and pinned: $\tau = 2 \sum_\rho |E_N(\gamma_\rho)|^2$ within certified allowances (Guinand–Weil, cited; at $x = 13$: $\tau = 2.499 \times 10^{-54}$ vs zero-side 2.402×10^{-54}), the smallness law $2|E_N(\gamma_j)|^2 \leq \tau + \text{OFF}$ at every polished band zero, and the certified gap law in the resolvability zone $\gamma \leq 2\pi x$ ($x = 13$: 21/21 zone zeros pinned to nodes, max gap $2.9 \times 10^{-17} \leq 5.6 \times 10^{-8}$ — exponentially close *by the variational mechanism*; edge layer measured-only). L1's tail half closes in closed form (HSW22 Cor. 1.2 + PT21, recomputed against an own IBP integral), and the crossover theorem makes the corpus constant a theorem: mode density == RvM density exactly at $T = 2\pi x$, resolvable band fraction == $1/\text{KFAC} = 0.8$. Independently reproduced in Bughunt IV from the classical explicit formula ($|\Delta \log_{10}| = 2.7 \times 10^{-7}$). Source probe re-run green as typed at promotion (31/31, SPEC 7d8cc2e5). The band half of L1 (H-pin) stays open; Z1 evidence typing stands. Not evidence for or against RH. Machine-checked: [verification/v919_secular_gw_pinning.py]. [E] (the secular identity, crossover and tail algebra, exact in-run) + [C] (the pinned GW/gap/jet tables, certified per rung against cited PT21/HSW22 envelopes) + [O] (H-pin — open, typed)

The loop / equivalence theorems — the anti-double-counting layer (PRIME.LOOP.EQUIVALENCE.THEOREMS.01). One module (17/17). The negative/structural theorems of rounds 140 and 142 that prevent double-counting in the proof graph forever, all recomputed exactly in-run: the equivalence loop (Theorem B2: modulo $\{\text{JETLOCK, TAILVIS}\}$, BAND-MASS $\Leftrightarrow$ TLAWCAP $\Leftrightarrow$ EPS-LOCK — band-mass is EPS-LOCK-*complete*, every band-mass proof contains an EPS-LOCK proof), the onset dictionary (J2: the JET-LOCK onset *is* the jet ratio, two-sided exact; J3: the jet ratio *is* escaped census-root mass, so JET-LOCK(poly) $\Leftrightarrow$ TOPROOT; J4: jet numerators are unconditionally polynomial — the hardness is the A_2/A_0 cancellation *alignment*), the pinch identity (W1: $1 - sg == (g^2/\rho^2) \sum \tilde{e}_i^2/(\delta_i(\delta_i - g))$ exactly — $s \times \text{gap} \equiv 1$ is *not* an identity, it is the pinch $1 - g/\delta_1 \leq sg \leq 1$), the loop (W2, both directions exact: QSUBGAP $\Leftrightarrow$ SUSCAP2R $\wedge$ DELTA1FLOOR) and the interlacing (W3: DELTA1FLOOR $\Leftarrow$ FULLGAP, a source-pure two-eigenvalue statement; measured *tight*, $\delta_1/\text{FULLGAP} = 1.0000$ at all five rungs), plus the exact witness that DELTA1FLOOR is *required* ($s \equiv 1$ while the gap $\rightarrow 0$; the Bughunt-IV F1 correction of record). Pinning split disclosed: the round-142 probe re-run green as typed at promotion (26/26, SPEC 85971e17, 1904.7 s); the multi-hour round-140 probe pinned from run-of-record (33/33, SPEC 85e7ba69, both logs kept) with its loop

algebra re-gated in Bughunt IV and recomputed here. These are *reshape* theorems: they close no omega — the census stays at cardinality 4. Not evidence for or against RH. Machine-checked: [verification/v920_loop_equivalence_theorems.py]. [E] (all nine theorems, exact algebra recomputed in-run) + [C] (the pinned per-rung tables incl. the tight $\delta_1 = \text{FULLGAP}$ lock, typed measured) + [O] (TOPROOT/ONSETCAP/SUSCAP2R/DELTA1FLOOR — open, typed)

The counting-class closures (PRIME.COUNTING.DOMINANCE.CLOSURES.01). One module (9/9). The pure classical-citation theorems of rounds 133 and 143: Theorem M (ball-counting slack dominance, pure counting — no sign reads), Theorem E (edge counting bounds, HSW-closed), Theorem T (*unconditional*: $N_{\text{fin}}(T) \leq N_{\text{true}}(T)$ for all $T \geq T^*(x)$, T^* the closed solve of $M - Q = K - 1$ consuming only the exact node count [v919] + HSW22; ladder 63.55/79.17/102.80/147.13 recomputed vs the classical γ_{K-1} anchors), Theorem C (chain sharpening, exact: MRB is *strictly weaker* than per-node one-sidedness — DOM is not needed and not claimed), Theorem A (assemblage, *conditional on H-pin*, closed forms recomputed: $x_0 = 121$, BW25 $x_0 = 112$; the Q-swamp obstruction carried, not smoothed: $D < 0$ on the battery strip $x \in \{13..89\}$), and Theorem T1 (TAILVIS existence is *classical*: every window of length $L^* = (1 + 2\text{err})/\rho = O(20)$ carries a true zero unconditionally, via the two-sided HSW envelope + convexity, sympy-gated — TAILVIS is eliminated as a standalone arithmetic omega, counting class) with Theorem T3 resolving the round-140 horizon limitation at $x = 24/28$ *without new zeros* (recomputed here from the v919 pins to $< 2\%$). The window carrier is disclosed ($x \lesssim 2.3 \times 10^5$, a carrier class like the census carrier, not a new omega). Pinning split disclosed: the round-133 probe re-run green as typed at promotion (40/40, SPEC 00b98f5e, 339.3 s); the multi-hour round-143 probe pinned from run-of-record (27/27, SPEC 4fcd70be, both logs kept), its T1 re-derived independently in Bughunt IV. Controls refuse at the named hypothesis H2 inside the verified zero-free gap (0, 14.13) — the mechanism claims WPD nowhere PD is false. Not evidence for or against RH. Machine-checked: [verification/v921_counting_dominance_closures.py]. [E] (Theorems M/E/T/C instances, T^* solves, Theorem-A closed forms, T1 algebra, $L^*/m_W/T3$ recomputed in-run) + [C] (the pinned per-rung certificates; Theorem A conditional on H-pin, typed) + [O] (H-pin and the open omegas — untouched)

The HPIN/spacing theorem family (PRIME.SPACING.JETSUMRULES.THEOREMS.01). One module (13/13). The exact-algebra backbone of rounds 135 and 154, all recomputed in-run: the derivative identity $E'_N(\mu_j) == 4 \sin(A\mu_j) F'(\mu_j^2)$ at every census node — the H-pin floor is F' -currency — with the spacing-product form $F'(y_j) == A_0 \prod_{i \neq j} (y_j - y_i) / \prod_k (y_j - b_k)$ (the floor is a *zero-spacing product*; D1), the jet sum rules $\sum 1/F' == -A_2/A_0^2$ and $\sum y/F' == -A_4/A_0^2 + A_2^2/A_0^3$ (D2: the boundary-jet telescope *is* the reciprocal-floor moment data) with the round-154 second-order rungs $\sum F''/F'^3 == 2A_2/A_0^3$ and $\sum [1/F'^2 - yF''/F'^3] == 3A_2^2/A_0^4 - 2A_4/A_0^3$ (P5, residue calculus), the A_0 -cancellation $g = c/(2|\sin|PR)$ (D3: the demand ratio is A_0 -free; the floor alone rides $\sqrt{\tau}$, typed, not a disguise), and the certified far-lattice tail (D4). The sign-uniform corollary is carried as an *obstruction*: its hypothesis is measured FALSE (sign census MIXED at every rung; the zone share of the sum-rule mass collapses $1.5 \times 10^{-4} \rightarrow 3.9 \times 10^{-13}$ — the moment/harmonic route cannot see the zone floor). Lean-hardened in round 158: the spacing product for *generic finite K over an arbitrary field* (SpacingProduct.lean) and all four sum rules at $K = 2$ with the general- K skeleton honesty-locked (JetSumRules.lean); the module re-checks the theorem names in the shipped sources. Pinning split disclosed: the round-154 probe re-run green as typed at promotion (31/31, SPEC f92b3fb5, 1572.7 s); the round-135 probe pinned from run-of-record (33/33, SPEC 80366b4e, three deterministic logs kept), its D1/D2 algebra re-gated by round 154 and Lean round 158. H-pin itself stays open (the round-135 omega split EPS-LOCK + SPACING-REMAINDER). Not evidence for or against RH. Machine-checked: [verification/v922_spacing_jet_sumrule_theorems.py]. [E] (D1/D2/P5/D3/D4 + gap-demand, exact algebra recomputed in-run; Lean names re-checked) + [C] (the pinned ladder tables, typed measured; the sign corollary conditional with its hypothesis measured false) + [O] (H-pin — open, typed)

The pinch/enclosure/razor theorems — the spectral-balance end-characterization

(PRIME.SPECTRAL.BALANCE.RAZOR.01). One module (20/20). The complete exact spectral-balance algebra of rounds 157 and 161 on the QSUBGAP g -floor, all recomputed in-run. Round 157: the trace loop $\tau \text{ TrH} == \text{tf}/\text{FULLGAP}$ *exactly* with $1 \leq \text{tf} \leq K-1$ *unconditionally* — the tail is closed by the count bound alone, so $\text{DELTA1FLOOR} \Leftrightarrow \text{TRACEFLOOR}$ is a proven two-sided poly equivalence (SB1; the round-146 recoordination was a loop); the chi-cap $s\rho^2\delta_1 \leq 1 - \rho^2$ (SB2, the third rate-blind moment instrument, measured vacuous by up to 88.8 dex); the enclosure $\rho^2\delta_1 \leq g \leq \delta_1$ (SB3, both ends exact; the one-moment merge refuted measured); the OVG identity (SB4: the round-150 OVG-flatness *is* the zone-top-gap pinch); the share floor (SB5, true but vacuous: the one-modedness is the weight-ladder race). Round 161: **the razor enclosure** $1/(s + 1/\delta_1) \leq g < 1/s$ (GF1, via the exact partial-fraction identities $S - \chi_t == gT_2$ and the spread form; it *dominates* the round-157 lower end via the chi-cap, and the exact two-level witness $\rho^2 = 1/(1 + P\delta_1)$ realizes $s == P = 10^6$ and $g ==$ the lower end *exactly*: no algebra-only improvement exists — **the g -floor is the s -cap given the δ_1 -floor**, nothing in between; measured width $1.51 \times 10^{-4} \rightarrow 8.45 \times 10^{-8}$); the pinch law $1 - sg == g^2T_2/\rho^2$ with the defect priced g/δ_1 (GF2); the one-sided share pricing (GF3); the Newton value law $N_1 == 1/(H_t + s)$ with $B(q_0) == -\rho^2P'_c(q_0)$ — the bordered value carries ρ^2 , the round-153 self-reference pinned — and the jet-ratio chase $J_g t_g == 1 + g$ (GF4, the zero-jet mechanism's third rung); and the S1 absorption + twin squeeze (GF5: the round-150 S1-floor is absorbed into the root separation — one decay law — and both final residue cores are *one statement-form at two weightings*; the value-merge is refuted at algebra level, the J-family is blind to g). Lean-hardened in round 158 (PinchIdentity.lean + SpectralBalance.lean, names re-checked in-run). W1/W2/W3 are cited from [verification/v920_loop_equivalence_theorems.py] — no double count. Pinning split disclosed: the round-157 probe re-run green as typed at promotion (26/26, SPEC 3ed38869, 4077.8 s, non-timing diff empty); the multi-hour round-161 probe pinned from run-of-record (26/26, SPEC cc783713, both logs kept), its GF algebra recomputed in the module. Reoordination only: no omega closes. Not evidence for or against RH. Machine-checked: [verification/v923_spectral_balance_razor_theorems.py]. [E] (SB1–SB5, GF1–GF5, the two-level sharpness witness — exact algebra recomputed in-run; Lean names re-checked) + [C] (the pinned razor/trace/twin-squeeze tables, typed measured) + [O] (the QSUBGAP g -floor, TOPROOT, TLAWCAP — open, typed)

The moment-Laurent / root-ladder theorems (PRIME.MOMENT.LAURENT.ROOTLADDER.01). One module (12/12). The round-156 family, all recomputed in-run: **the ladder is moment data** (L1: $yS == \sum v + T$ exactly; with $\sum v = a_2 = -y_t$ and $z = y/y_t$, $(y/y_t)F/A_0 == \Phi(z) = z - 1 + \sum_m J_{m+1}z^{-m}$ with the exact partial-geometric remainder — the census roots above the band are the zeros of the moment-Laurent function: self-similarity iff moment flatness); **the quarter-cap** (L2: $z(1-z) \leq 1/4$ and $\Phi(z_0) = 0 \Rightarrow J_2 == z_0(1-z_0) - z_0\rho(z_0) \Rightarrow J_2 \leq 1/4 + z_0|\rho|$ — the census-real top root caps its *own* leading moment ratio; measured $z|\rho| \leq 0.0102$, so the saturation $J_2 \rightarrow 0.1506$ has *proven* headroom); the exact sum rules $a_2 == -P_1$, $P_2 == a_2^2 - 2a_4$, $P_3 == 3a_2a_4 - 3a_6 - a_3^2$ (L3: the ladder power sums *are* the jets); the sign-pattern law (L4: $n_{\text{esc}} \leq \text{nsc} + 1$ exact; the Laguerre form cited; $V == n_{\text{esc}}$ measured at 5/6 blocks, the b28 slack disclosed); the cascade (L5: $yF_j == a_{2(j+1)} + F_{j+1}$ exactly, so $T > 0$ holds *pointwise*, *source-pure* down to $Y^* = 1.02\text{--}2.1 b_{\text{top}}$ with zero cache violations — the escaped-root cap is *certified*, not measured); and the two-sided split (L6: the far window is controlled by J_2 alone). The wall in final form travels in-module on exact rationals: the e_0 -witness deflates $J'_m == J_m P^{(1-m)/2}$ while $T'/y'_t == T/y_t$ *exactly* (the shape sector is scale-blind), and the 2-mode witness inflates $J_2 \times 10^6$ with all identities intact — **J-boundedness is arithmetic-pinned**, refused only by the census-minimizer. Lean-hardened in round 158 (MomentLaurent.lean incl. T_laurent with the explicit exact remainder; names re-checked in-run). Source probe re-run green as typed at promotion (29/29, SPEC 02755d6b, 1873.5 s, zero amendments). T-WINDOW is rewritten as {arithmetic J_2 -window} + {band-edge sliver + separation}; no omega closes. Not evidence for or against RH. Machine-checked: [verification/v924_moment_laurent_rootladder.py]. [E] (L1–L6 + the witnesses, exact algebra recomputed in-run; Lean names re-checked) + [C] (the pinned ladder/moment/cascade tables, typed measured) + [O] (the arithmetic J_2 -window and the band-edge legs — open, typed)

The edge/cleanup closures — simplicity falls, the Q-swamp closes wholesale (PRIME.EDGE.CLEANUP.CLOSURES.01). One module (14/14). The round-159 finite/classical closures. **Recomputed in-run at every suite run** from the committed PT21-warranted verified-zero cache (re-warded; every read typed ward/classical-census-below-horizon, max height consumed $7264.75 \ll 3 \times 10^{12}$): the Q-swamp wholesale closure — $D_{cs}(x, a) := (7/8) \text{tail}_{cs} - (N-m) w_a(T_z) > 0$ at *all* 357 Turing-class local band certificates (integer $x = 3..121 \times \text{battery}$ $a \in \{1, 4, 16\}$; worst margin 0.346 at (12, 1), matching the run-of-record), the representative tables $x = 30/60/90$ (the swamped $D_{hsw} < 0$ flips to $D_{cs} > 0$), the $D_{hsw} < 0$ battery strip replicated, and $x_0(\text{HSW}) == 121 / x_0(\text{BW25}) == 112$ on the integer scan — the bridge is gap-free, so **Theorem A’s conditionality sharpens to “H-pin(x) implies $\{d_1 > 0, \text{MRB}\}$ for every integer $x \geq 3$ ”** (H-pin itself untouched; the swamp *obstruction* falls, not the omega). The simplicity kill (exact layer recomputed): $\text{disc} == \prod (\lambda_i - \lambda_j)^2$ generic, and the round-147 LM split forces $\delta_1 \geq 1/(B-1) > 0$ at every selected point — the selected points are *automatically* simple, so census row Z8 was double-counted inside Z4 at demand level; with zero-cost avoidance (isolated degeneracies, measure-0 cover exact), **Z8 falls** ($10 \rightarrow 9$ census rows; the residual NONDEGENERATE-CELL is witness-certified for free). Pinned from run-of-record: the sliver closure (two-sided audit-ball certificates $0 < T_{lo} \leq T_{hi} < 1.5 y_t$ at every sliver + first-zero target, $1/1/1/1/18/51$ at b5..b28; the certificate price rides $e^{-\text{depth}}$, $\delta = 10^{-8} \rightarrow 10^{-44}$ — the f64 cache-ball dies from b13 on, machine-pinned), the exact implicit separation law gated as an identity (residuals $\leq 5 \times 10^{-27}$), and the λ -uniform demand typed (band-edge zero repulsion of 0.22–0.43 RvM mean spacings with arithmetic-signed-input width, TAILVIS-style horizon typing). Source probe re-run green as typed at promotion (34/34, SPEC f6c03188, 1830.8 s). Z8 was never one of the four min-cut omegas — the census stays at cardinality 4. Not evidence for or against RH. Machine-checked: [verification/v925_edge_cleanup_closures.py]. [E] (the E2 subsumption/avoidance algebra, exact; the 357 census certificates + x_0 scans recomputed in-run from the committed cache) + [C] (the pinned sliver/separation tables; Theorem A conditional on H-pin, typed) + [O] (H-pin and the open omegas — untouched)

The quartic/growth-law theorems (PRIME.FULLGAP.GROWTHLAW.THEOREMS.01). One module (12/12). The round-162 family, the exact layer all recomputed in-run: **the leave-one-out instrument** (GL1: every leave-one-out ground matches λ_1 within the ε^2 budget — the pinch position is the honest discriminator; GL2: the loo problem *is* the exact arrowhead compression, $\det == \prod (q_i - \lambda) \times \text{secular}$ generically, with the dual row $R^T(RR^T)^{-1}e_j$ and the Bughunt-V numeric instrument re-verified on an own deterministic instance); **the razor collapse** (GL3: single-row interlacing + the $R = \varphi$ equality witness + razor vacuity $1/(s+1/F) \leq F$: D3 collapses to the razor — algebra-only per-row/per-zero price bounds refuted); the rate bookkeeping (GL4: $J t_r == 1 + \text{FULLGAP}$, $j r t_r == 1 + 1/\text{FULLGAP}$); and the ladder/quartic chases with the razor composition (GL5: **the QSUBGAP-floor flows from the Θ -window through the razor**). **The quartic law is typed MEASURED, not proven:** $J := (A_0(\psi_1)/A_0(\varphi))^2 == \Theta T_z^4$ with $T_z = 2\pi x$ (the proven round-131 crossover) and Θ flat in $[0.17, 0.26]$ over 24 dex of jet collapse; the independent Bughunt-V free-exponent/AIC adjudication is *recomputed in-run* from the pinned record J-table ($p = 3.9072 \pm 0.1136$; AIC prefers fixed 4 (−30.87) over free (−29.79) and rejects 3.5/4.5 at 3.6/5.2 σ ; FULLGAP slope 3.971 recomputed). Pinned: $\rho_j == 1.0000$ for *all* 189 left-out zone zeros (jet-collective — the per-zero deflation hypothesis refuted measured), add-one free at true zeros (contrast to 2.9×10^{17} ; $x = 24/28$ F64-typed), the trial cap mid-dominated, and the finite- P moment model undershooting by 1.4–4.5 dex (the Y3/R4 rate-blind trace-cap vacuity class, one level higher). Pinning split disclosed: the multi-hour round-162 probe pinned from run-of-record (28/28, SPEC 26bdb5a8, both logs kept, timing-normalized diff empty), its GL algebra re-gated in Bughunt V. Only arithmetic-consuming windows may pin Θ — the window stays open. Not evidence for or against RH. Machine-checked: [verification/v926_fullgap_growthlaw_theorems.py]. [E] (GL1–GL5 + the razor algebra + the AIC instrument, recomputed in-run) + [C] (the quartic law and the ladder/loo/add-one tables, typed measured) + [O] (the Θ -window — open, typed)

The cofinal block-average substrate (PRIME.BLOCKAVERAGE.SUBSTRATE.01). One module (12/12). The round-166 frozen-block certification machinery — the substrate of the endgame arc —

all exact legs recomputed in-run: BA1 (extraction: a certified block sum > 0 forces ≥ 1 positive rung; the dyadic hits are cofinal), BA2 (**the determinant chain is the τ sign**: leading minors $> 0 \Rightarrow \text{sign}(\lambda_{\min}) == \text{sign}(D_K)$, Jacobi/Sylvester cited), the frozen weight families with the sign equivalence, BA3 (**the budget floor $\tau \geq \text{zsum} - \text{OFF}$ exactly**, proven-mod-cited-inputs below the verified horizon: PT21 census + HSW22 envelope + the round-131 OFF recipe + ward-class cache — no tlaw window, no WPD, no-loop), the Weyl-split lemma (the source-only additive route, measured vacuous by 10.9–54.6 dex: the cancellation *is* the arithmetic), and the loop/red-team layer (the tlaw-window route typed LOOP, not consumed; free scalars realize both signs). Pinned: the certified block enclosures (Rayleigh upper + Cholesky lower at every rung) with *all* lower ends > 0 on the complete dyadic blocks B2/B3 and the BA3 budget floors > 0 — **positive-rung-per-block certified below the horizon**; the wall dictionary instantiated at all 25 rungs $h = 4..28$ ($\text{sign}(\tau) == \text{sign}(\text{wall}) == +1$, logdet cross-devs $3 \times 10^{-35}..5 \times 10^{-68}$); $\text{zsum}/\tau = 0.88..0.96$ with margin $\geq 3.2 \times 10^8$ ($h = 27/28$ F64-typed); the tlaw ladder $0.2325 \rightarrow 0.5778$ with 19 new corpus-depth rungs; the averaging signal measured ($0.461 \rightarrow 0.037$, mechanism open); the controls refuse with a sign flip of every block sum. Source probe re-run green as typed at promotion (27/27, SPEC d86f42a0, 2372.4 s, timing-normalized diff empty). The λ -uniform demand beyond the horizon is recoordinated to the AVG-BUDGET-WINDOW and stays open; the bypass adjudication is partial ($\{\text{L1}, \text{WPD}\}$ untouched). Not evidence for or against RH. Machine-checked: [\[verification/v927_blockaverage_substrate_theorems.py\]](#). **[E]** (BA1/BA2/BA3/Weyl-split + the weight families, exact algebra recomputed in-run) + **[C]** (the pinned enclosure/wall/ladder tables; BA3 instantiation proven-mod-cited below the horizon) + **[O]** (the AVG-BUDGET-WINDOW beyond the horizon — open, typed)

The depth-block transfer theorems (PRIME.DEPTHBLOCK.TRANSFER.01). One module (11/11). The round-168 structural core of the endgame, recomputed in-run: DT1 (**proven**: the transfer step is exact algebra on top of BA3), DT2 (**the demand law, proven-by-recipe — the round's discovery**: $\varepsilon == \sqrt{h}(1 + \eta)^2 G(T_{\text{PT}})/G(2\pi h)$ exactly, with the dyadic demand factor falling monotonically onto $2^{3/2}$ — a sympy limit), **the census 3/2-law** (sympy-exact: $T_{\text{req}}(h) \rightarrow (3\pi/\sigma_0) h^{3/2}$ — census consumption grows strictly faster than the block, so *the budget route can never become self-supporting*), the budget horizon recomputed in-run ($h^* = 1.2566 \times 10^7$ at rel 2×10^{-3} vs the record, $k^* = 23.58$: ~ 22 complete dyadic blocks on PT21), the Bertrand entry interface (cited + sieve-verified in-run for every integer $2 \leq h \leq 10^6$: the dyadic gap is never empty), and **the RH-loop detection** (universalizing the census closes the cycle $\text{RH} \rightarrow \text{CENSUS}[\text{all } k] \rightarrow \dots \rightarrow \text{RH}$, machine-detected; the per- k schedule is acyclic — the all- k grant is carried only as a flagged loop edge). Pinned: the σ/ε ladder ($\sigma = 0.2056 \rightarrow 0.5191$ measured, DT3; recipe devs $\leq 10^{-40}$ at every rung), the dyadic factors $3.7288 \rightarrow 2.8462$ monotone toward $2^{3/2}$, **the step instantiated end-to-end** (STEP(B2→B3) 9/9, STEP(B3→B4-partial) 11/11 — substrate-direct below the horizon, no self-supporting induction: each block consumes fresh primes and fresh census), ENTRY-NEW confirmed 4/4 (cone entry always at the largest *new* prime atom of the dyadic gap; the fakes die by no-entry), and the controls refusing base *and* step. Source probe re-run green as typed at promotion (36/36, SPEC a4cd0714, 2371.6 s, zero amendments, timing-normalized diff empty). **The final coordinate is named**: the AVG-BUDGET-WINDOW factorizes into [census schedule, classical per k , loop if for-all- k] $\times$ [SIGMA-FLOOR — the entire remaining λ -uniform arithmetic content, arithmetic-pinned, open]. Not evidence for or against RH. Machine-checked: [\[verification/v928_depthblock_transfer_theorems.py\]](#). **[E]** (DT1 + DT2-by-recipe + the 3/2-law + Bertrand + the horizon + the loop graphs, recomputed in-run) + **[C]** (the pinned step/entry tables and the σ ladder, typed measured) + **[O]** (SIGMA-FLOOR — open, typed; factorized in [\[verification/v929_sigmafloop_factorization.py\]](#))

The sigma-floor terminal factorization (PRIME.SIGMAFLOOR.FACTORIZATION.01). One module (12/12). The round-169 official record of the endgame's terminal coordinate, the exact layer recomputed in-run: **the supply factorization** (SF1: $\sigma == (1 - \text{slop}) \delta \text{DC}$ exactly — the per-term algebra of the round-131 Layer-1 chain transplanted into the supply window; identity devs $\leq 2 \times 10^{-60}$ at all 25 rungs in the record, F64-immune — the supply factorizes into [jet mass] $\times$

[equidistribution mass]), the anti-lattice reduction ($\sigma == 0$ forces every tail zero into the finite kill set), **the onset-cap refutation + the rate floor** (SF2: two exact instances satisfy the same onset-excess cap with $\sigma = 3/2$ and $\sigma = 1/100$ — the conjectured chain dies; pointwise JET-LOCK $\Rightarrow \sigma \geq (1 - \text{slop})(1 - \rho)^2$ DC exactly), **the DC leg proven-mod-cited per census** (SF3: Abel/Stieltjes + the Landau main integral exact, both limit chases $\rightarrow 0$; Landau 1912/Gonek 1993 as form, the Gonek constant unpriced — the DC-classical typing; the all- k identification is the flagged RH loop), **the demand-rate absorption** (SF4, sympy-exact at $a = 0, 1/2, 1, 3/2$: any explicit polynomial-rate floor is census-absorbable — the measured flatness of σ is not needed), the pinning-supply loop (SF5, machine-detected), the red team (SF6: jet-mass and DC-leg algebra-only refuted), and the three endgame graphs (two loops detected, the factorized per- k terminal chain acyclic). Pinned: DC = 0.1535 $\rightarrow$ 0.4463 rising toward $1/2$ and $\delta = 1.16..1.43$ $O(1)$ -flat — **the round-168 σ -flatness explained as two trends** (the last unexplained measured law of round 168 decomposed); the rate floor per rung with the clean-rung rate law $a = 1.328$ (amendment disclosed: the all-rung fit is cache-top-limited) and the rate horizon $k_{\text{rate}}^* = 12.2$; the anatomy block floor certified on B2/B3; and the sharpest controls finding: the raw floor *holds* in every fake world while the BA3 bridge is *false* — the arithmetic content is the {floor, bridge} pair. Source probe re-run green as typed at promotion (35/35, SPEC a16a4db1, 2375.2 s, timing-normalized diff empty). **The terminal statement:** SIGMA-FLOOR == [DC-leg, classical per census, DC $\rightarrow 1/2$, all- $k == \text{loop}$] $\times$ [**the jet-mass-floor** — the terminal λ -uniform residue, arithmetic-pinned, per-rung classical, rate open, *not* claimed]. Not evidence for or against RH. Machine-checked: [verification/v929_sigmafloor_factorization.py]. [E] (SF1–SF6 + the endgame graphs, exact algebra recomputed in-run; SF3 proven-mod-cited) + [C] (the pinned anatomy/rate tables, typed measured) + [O] (the jet-mass-floor — the terminal λ -uniform residue, open, typed)

The window-instrument mechanism record (PRIME.WINDOW.INSTRUMENT.MECHANISM.01). One module (10/10). The round-167 positivity-transport instrument and the accretion/entry mechanism, at their honest grade (the v916 CERT-NUM precedent). Recomputed in-run: WI1 (plant transport: the PSD premise survives positive band mass at *any* strength — the plant sandwich + the deflation plateau), WI2 (the ghost secular threshold: PSD iff $s \leq s^* \leq \tau/(\lambda_P w_0^2)$ — the ghost price collapses with the Connes collapse), WI3 (the perturbation law, first-order symmetric: the plant/ghost asymmetry is the validity-range asymmetry, not the derivative), WI4 (the budget-moment dictionary $2E^2 == 8A_0^2 \sin^2 y_t^2 \Phi^2/y^3$, with round-156 L1 cited from [verification/v924_moment_laurent_rootladder.py]), WI5 ($\Theta == c_1^2$ + the theta chases; the self-cap class is blind to Θ , hard-asserted), WI6 (cofinality: **BANDPOS(unbounded ladder) $\iff$ RH** — the loop identification, bookkeeping-grade), and the Stieltjes-moment refutation recomputed from the pinned slots (the shifted Hankel not PSD + the log-convexity break ≥ 1.5 at every deep rung: the slots are *not* the moments of a positive kernel). Pinned, typed measured: **the mechanism finding** — along the pre-frozen source-built accretion path *no partial comb is positive*: the cone entry happens only in the tail of the last atom ($t^* \geq 0.9997$) with the tangent criterion holding from the prime source ($-v'N_q v > 0$ at the touch), and all fakes fail by no-entry; independently re-confirmed at true dyadic pairs by the round-168 batteries (4/4, re-run green at this promotion); chain-not-assembled typed ($n = 3/5$ atoms: not a theorem for unbounded combs). The honest demotion is carried: the plant/ghost asymmetry *law* is generic-cone — the arithmetic content is where the boundary sits and the anchor values. Gate A adjudicated: the slot ladder only approximately dyadic (15–17 percent), the held-out prediction mixed 2/4. Pinning split disclosed: the multi-hour round-167 probe pinned from run-of-record (46/46, SPEC bfdc374, both logs kept; the mid-run re-freeze disclosed). Not evidence for or against RH. Machine-checked: [verification/v930_window_instrument_mechanism.py]. [E] (WI1–WI6 + the Stieltjes refutation, recomputed in-run) + [C] (the mechanism/instrument tables, typed measured; the asymmetry law demoted generic-cone) + [O] (the window omegas — untouched)

The jet-mass product-floor theorems (PRIME.JETMASS.FLOOR.01). One module (10/10). The round-171 family: the jet-mass floor (the terminal λ -uniform residue named in [verification/v929_sigmafloor_factorization.py]) receives its rigorous per-rung theorem. Recom-

puted in-run: PF1 (the census product identity $N(y) == A_0 \prod_j (y - y_j)$ with the Vieta trace $\sum_j y_j == B_1 + y_t$ at *coefficient* level, no root-finding — Newton/Vieta resum the entire J-tail into root data), PF2 (**the product floor**: $F(y)/A_0 \geq (1 - c^*/z)^{(1+\kappa)/c^*}$ for every real $z > c^*$ given H1 + H2 — **the exponent is the trace**; the round-140 far-field law $1 - y_t/y$ is the $\kappa \rightarrow 0$ shadow of this exact bound, its measured 1.2-percent tightness explained), PF3 (half-plane exclusion, source-pure: H1 is *one* exact source evaluation per rung — no cache, no zeros), the JMF assembly ($\delta \geq L^2$ WF; WF is the classical $(G - C)/2$ suffix, the same Landau/Gonek class as the round-169 DC leg, constant priced in [verification/v934_gonek_pricing_unconditional.py]; the rate limit $4\pi/q$ sympy-exact; any polynomial rate census-absorbable), and the modus tollens (the round-169 δ -toy *violates* the PF2 conclusion hence is not realizable under H1 + H2; the 2-mode witness kills the certificate pair while every identity holds). Pinned: H1 certified at all 25 rungs ($c^* = 1.10$ – 1.15 flat); H2 census complete-real nonnegative at all 25 rungs incl. degree-116 at $h = 28$; the certified curve under the truth at every one of $\sim 100k$ true tail zeros (min margins $3.5 \times 10^{-5} \rightarrow 0.17$, all positive); $\delta_{\text{cert}} = 0.1035/0.0603/0.0351$ with margin $\geq 8.2 \times 10^7$; the B2/B3 block certificates run through the product floor — the round-169 measured-lock ancestor is *eliminated*. Bughunt-VII corrections adopted: two vacuous exact-layer legs re-typed definitional (F3, recomputed honestly in the module); the composed per-block hypothesis is the **triple** {H1 $\wedge$ H2 $\wedge$ H3}-**cofinal**, one rung per dyadic block, all three at the same h — not H3 alone (F1). Not evidence for or against RH. Machine-checked: [verification/v931_jetmass_floor_theorems.py]. [E] (PF1–PF3 + the JMF assembly + the modus tollens, exact algebra recomputed in-run) + [C] (the H1/H2/pointwise/rate tables, typed per leg) + [O] (the λ -uniform rate — open, typed, reduced to TOPROOT)

The TOPROOT statement and the quartic certificate (PRIME.TOPROOT.THETA.01). One module (10/10). The round-172 family: the last λ -uniform edge pinned to *one* named per-rung hypothesis. Recomputed in-run: T1 ($\text{TOPROOT}(p, C) == y_t \leq Ch^p$ with the exact SEQ-cofinal quantifier — exists (C, p) s.t. every dyadic block has a rung with $y_t \leq Ch^p$; an all- h reading is *not* demanded — and three machine-locked forms: theta-form $\iff \text{TOPROOT}(4)$, census form, rate form), **theorem TR-CAP** (no census root above $(1 + 2\rho) y_t$ given $|J_{m+1}| \leq \rho^m$ — proven, and typed *circular for TOPROOT*: the cap is y_t -normalized; Fujiwara’s sharpest term $==$ the trace $B_1 + y_t$ exactly), the Vieta pinch killed (every symmetric function carries $1/A_0$), the A_0 -triangle route flagged as **the fourth loop route** (exponentially vacuous *and* consuming {TAUPOS, TLAWCAP}; cycle machine-detected), **the rate dictionary** $a = p/2 - 1$ proven at $p = 3, 4, 5$, the admissibility recomputed from closed forms ($\varepsilon_{\text{closed}}(56) = 4.5338 \times 10^{-9}$, $a_{\text{max}} = 4.1348$, $p_{\text{max}} = 10.2695$: the measured $p_{\text{all}} = 4.18$ leaves six powers of h of margin), and the witness in both directions ($\theta'' = 62.69 > \text{bar}$: **H3 is refutable**; source price $8.1 \times 10^{-2} \rightarrow 10^{-17.6}$: TOPROOT is *not* norm-continuous — any proof must consume the arithmetic sign structure). Pinned: **H3** ($y_t \leq 0.155 T_z^4$, one source evaluation per rung, ancestors $== \{\text{SOURCE}\}$) certified at all 25 rungs + the deep holdout $h = 30$ (degree-127 source) with margin ≥ 1.99 ; $\rho == |J_2|$ at every rung with cap 1.21–1.30 vs certified $c^* = 1.10/1.15$ (the certified constant stays sharper). Bughunt-VII F1 adopted: the residue is the **triple** {H1 $\wedge$ H2 $\wedge$ H3}-**cofinal**. Not evidence for or against RH. Machine-checked: [verification/v932_toproot_theta_statement.py]. [E] (T1 + TR-CAP + the dictionary + the admissibility recompute + the witness algebra, exact) + [C] (the theta/rho/lock ladders, typed measured) + [O] (the cofinal extension — the open edge, typed)

The H3-cofinal adjudication (PRIME.H3.COFINAL.01). One module (10/10). The round-173 family: the three named mechanisms of the cofinal proof attack adjudicated with numbers. Recomputed in-run: the pigeonhole/defect-collapse theorems (cofinal(bar) + defect- $D \Rightarrow \text{forall-}h(\text{bar} + D)$; positive levels have nothing to cancel — the averaging subsidy is *empty*), the transport identities ($\Theta_{\text{FG}} == \theta_y \times \text{lock}$; H3 and the round-162 window are equivalent on the two-sided lock manifold; the measured ceiling $0.1197 < 0.155$ consumes the [verification/v926_fullgap_growthlaw_theorems.py] *measured* quartic law — typed conditional-on-measured, flagged, not delivered), the Davis–Kahan stability lemma, the manifold exclusion (lock'' $==$ lock/ W exact, both directions), *and all saturation analytics* (fit code ported verbatim: the five models — every saturating model beats the power law by

factor ≤ 0.60 in RSS and at the $h = 30$ holdout; t_∞ band $[0.0766, 0.0977]$; the local exponent descent $4.2991 > 4.1203 > 4.0600 > 4.0236$ — **the growth law converges to the exact quartic at depth**, $p_{\text{loc}} \rightarrow 4.024$; the quantifier gap $D = 0.004183$ — the limsup form holds only *mod* D (Bughunt-VII F2); the block subsidy $0.7533/0.9233/0.9604 \rightarrow 1$). Pinned: the DK radii $4.5 \times 10^{-25} \rightarrow 6.6 \times 10^{-6}$ strictly growing with crossover $h = 16$ — **the manifold-exclusion verdict is scoped to the DK radius** (gated $h \leq 13$, measured to $h = 20$; Bughunt-VII F4: the lock leg excludes only large dials); the 2-mode witness breaks {ground-state certificate, lock window, BA3 bridge $\times 3.6 \times 10^8$ }; the 3-mode escalation costs $\times 10^5$ and still breaks the same three (escalation-stable); at measured residuals H3 is norm-stable. θ_∞ stays *open* in the band under the bar (margin 1.586; $1/(4\pi)$ inside the band, recorded-not-claimed). Not evidence for or against RH. Machine-checked: [\[verification/v933_h3_cofinal_adjudication.py\]](#). **[E]** (the pigeonhole/transport/DK/manifold algebra + all analytics recomputed in-run) + **[C]** (the DK radii and witness tables, typed measured; the ceiling conditional-on-measured, flagged) + **[O]** (θ_∞ — open, typed)

The unconditional Gonek pricing (PRIME.GONEK.PRICING.01). One module (8/8). The round-174 family: the “Gonek constants” item of the endgame residue priced and *leaving* the program residue. Recomputed in-run: the exact classical statements with their conditionality ([L] Landau 1912, Math. Ann. 71 — $\sum_{0 < \gamma \leq T} x^\rho = -(T/2\pi)\Lambda(x) + O(\log T)$ over *all* nontrivial zeros, unconditional; [G] Gonek 1985/1993, Contemp. Math. 143 — uniform with $|E| \leq c_G x \log(2xT) \log \log(3x)$, unconditional; [R] Gonek 1984 — RH-conditional == loop-if-consumed, machine-checked *not an ancestor* of either leg, the would-be hidden cycle detected and flagged; externally re-verified in Bughunt VII), **the envelope closed form** (the T_{hi} -dependence collapses to a single $-1/(2T_{\text{hi}}^2)$ term with a finite ceiling — census-depth-insensitive: a deeper census can never inflate the classical remainder), and the prefactor-insensitive absorption with *symbolic* c_G at $p = 2.5$ (the census schedule tolerates the classical error terms at any finite constant). Pinned: $\hat{c} \leq 0.085981$ over the full 12×6 spike table on the 20M-zero cache (snr up to 26592.6: the Gonek form over-covers $\geq 11\times$) — typed *constant-empirical-per-census* (no published numerically explicit constant exists); the DC leg replicates round 169 at all 25 rungs; the WF leg holds the exact perturbation bound hard; the controls refuse $\geq 100\times$ through the same instrument, with the dilation witness re-creating the true spike at $x' = 5^{64/65}$ to 1.4×10^{-7} . The on-line rewrite stays per-census; the all- k reading remains the flagged loop. Not evidence for or against RH. Machine-checked: [\[verification/v934_gonek_pricing_unconditional.py\]](#). **[E]** (the statements + the envelope closed form + the symbolic absorption + the loop graphs, exact) + **[C]** (the spike/DC/WF/control pricing tables, per census) + **[O]** (the all- k identification — the flagged loop, untouched)

The mode-level Landau bridge and the conditioning wall (PRIME.THETAINF.PIN.01). One module (9/9). The round-175 family: the classical pin of θ_∞ does *not* land, and the round proves exactly why — delivering the program’s **first linear per-mode classical identity**. Recomputed in-run: the bridge closed forms $(\int_0^L \sin(\omega u) e^{igu} du == \omega(1 - e^{2iAg})/(\omega^2 - g^2)$ at mode frequencies; $2 \text{Re} == 4\omega \sin^2(Ag)/(\omega^2 - g^2)$; the resonance $\gamma \rightarrow \omega_k$ removable exactly; the trivial-zero density == $1/(t(t^2 - 1))$, the dictionary covariance (**a bijection in θ** — it transports every θ_∞ and pins none, proven), the Rayleigh–Schrödinger typing (second-moment class only inside the validity radius — measured broken), the transport divergences (the Vinogradov–Korobov ceiling *and* even the flagged RH-grant transport diverge at mode scale: cancellation-blindness, not conditionality alone; the new Montgomery-PC loop cycle detected, never consumed), and the interlacing refutation (the measured sign census refuses the one-signed premise at every rung; the trace ceiling is self-referential). Pinned: **the bridge lands per census** — residuals $1.42 \times 10^{-5} \rightarrow 5.37 \times 10^{-5}$ at the full 20M-zero census with a clean $\sim 1/T$ tail law; the fluctuation carries ≥ 99.2 percent of θ ; **the variational conditioning wall** (Bughunt-VII F7: a *measured-law* extrapolation): the reconstruction fails at full census and $T_{\text{req}} = 3.76 \times 10^{14} \rightarrow 1.75 \times 10^{77}$ vs $T_{\text{PT}} = 3.0 \times 10^{12}$ — the $1/A_0$ circularity relocates into the variational conditioning; the second-moment route triply dead; the bridge is witness-data-invariant (exact) and separates the fake worlds $\times 16449.9/ \times 103617.3$. θ_∞ is re-typed **open-nonperturbative-variational** (deeper census improves the data $\sim 1/T$ but provably never the limit). The residue after rounds 171–175 (Bughunt-VII F1/F2): the **triple {H1 $\wedge$ H2 $\wedge$ H3}**–

cofinal (one rung per dyadic block, all three at the same h ; the limsup form only mod the measured defect $D = 0.004183$) + {census-forall- k == loop, flagged} + {L1, WPD} — cardinality unchanged. Not evidence for or against RH. Machine-checked: [verification/v935_thetainf_landau_bridge.py]. [E] (the bridge closed forms + covariance + RS + the divergences + the interlacing algebra, exact) + [C] (the residual/wall/control tables, per census; the T_{req} wall a measured-law extrapolation) + [O] (θ_∞ — open-nonperturbative-variational, typed)

The tau-free DK exclusion theorem and the transport ledger (PRIME.MANIFOLD.INVARIANCE.01). One module (10/10). The round-177 family: the frontal attack on the Bughunt-VII F4 scope gap — the round-173 manifold exclusion universalized. Recomputed in-run: U1 (**the tau-free universal DK exclusion:** $\sin \theta \leq (r_0/\tau)/(FG - a)$ — τ *cancels* in ratio form, so the DK radius $R_{\text{univ}}(\text{bar}, h)$ is computable from source functionals alone; contrapositive: $R_{\text{univ}} < W_{\text{min}} - 1 \Rightarrow$ no certificate-passing fixed- M perturbation refutes H3 — direction-universal, witness-free; **proven** $h \leq 13$ **at the frozen** 10^{-25} **bar**, measured-residual form to $h = 20$, not finite at $h \geq 16$ at the fixed bar — the split kept per Bughunt VIII), U2 (the refuter dial window: lock'' == lock/ W ; the surviving window is nonempty iff $\text{TFG} > 0.155$, exception exactly $\{h = 4\}$), U3 (the induction implication with $L_{\text{NEED}} = \text{TFG}_{\text{CAP}}/0.155 = 1.7254$ recomputed — the cap premise stays v926-measured, flagged), U4 (**the BA3 scale-gauge theorem:** zsum and OFF are homogeneous degree 2, so absolute-currency BA3 is passable by scaling — not a universal catcher), U5 (frame transports + dial algebra), and **the Bughunt-VIII F7 pairing rule:** the proven floor is the $b^*(h)$ schedule — 23.8/21.7/15.7/4.4 orders above the bar at $h = 4/5/8/13$, none at $h \geq 16$ — always cited paired with the measured full-space price ladder ($1.35 \times 10^5 \rightarrow 6.73 \times 10^8$, i.e. 30–33 orders, strictly growing; mechanism: **alignment-sharing**, the low eigenvectors share the source's $1/A_0$ cancellation, gap $2.354 \rightarrow 3.669$ measured). The forward-invariance/induction route is priced dead *as a reduction*: the transport hypotheses sit in the same epistemic class as the residue they would discharge (transport-relabels-not-reduces; level-cheaper-than-increment) — the infinite quantifier does not fall by induction. Not evidence for or against RH. Machine-checked: [verification/v936_manifold_invariance_exclusion.py]. [E] (U1–U5 + the pairing arithmetic, exact, recomputed in-run) + [C] (the R_{univ} /price/alignment/zmin/transport ladders, typed measured) + [O] (the $h \geq 16$ coverage at the fixed bar — b^* -conditional, typed)

The L1/WPD consolidation and reduction (PRIME.L1WPD.CLOSURE.01). One module (10/10). The round-178 family: the two counting-class remainders of the canonical residue consolidated — label-level, machine-gated. Recomputed in-run: the restatement licenses (the r135-D3 rearrangement with the A_0 -free ball radius; $K(q) = 2q$; Theorem-C with the exact slack; the Theorem-A shape), **the linearity adjudication** (the eigenvector map is not additive — $\lambda_{\text{min}}(A + B) = -\sqrt{2} \neq -2$, exact — and the census-root map not affine: the pin floor lives on the *vector* side of the mode-level Landau bridge, the [verification/v935_thetainf_landau_bridge.py] conditioning wall applies verbatim), and **the AND-fire demonstration at the declared edges:** the H-pin grants fire the WPD battery and L1 while the r171 jet-triple grants fire PF/HCOF but *not* HPIN/WPD — **WPD's λ -uniform content is the H-pin edge:** the pair {L1, WPD} carries *one* open λ -uniform edge, not two. The three-part bridge-expressibility verdict: the pin's source data are bridge-expressible per census (residual ladder $2.73 \times 10^{-4} \rightarrow 2.09 \times 10^{-5}$, hitting the round-175 table); the floor escapes linearity at exactly two maps (exact exhibits); the classical SW pricing is *vacuous* at battery rungs — no closure. Omega-a is quotient-class with the A_0 -floor route the flagged loop — the same variational-quotient *class* as the θ_∞ face, a *distinct* statement. The v925 all- x sharpening is propagated onto the residue surface ($x_0 = 121/112$ own scan; all 357 $D_{cs} > 0$); the r133-vs-r171 H1/H2/H3 name collision is flagged on the record. Not evidence for or against RH. Machine-checked: [verification/v937_l1wpd_closure_reduction.py]. [E] (the licenses + the linearity exhibits + the AND-fire closure, exact) + [C] (the replication and exhibit tables, per census) + [O] (H-pin — the one λ -uniform edge, open, typed)

The exact census semigroup and the threefold dictionary (PRIME.DBN.HEATFLOW.01). One module (11/11). The round-179 family: the one big classical import never tried before — the

de Bruijn–Newman heat flow (Rodgers–Tao 2020 $\Lambda \geq 0$ and Polymath15 2019 $\Lambda \leq 0.22$, both unconditional, consumed as *cited ceilings* only) set against the census observables. Recomputed in-run: the factor-4 normalization lemma (admissible γ -window $[0, 0.22/4] = [0, 0.055]$ exact; Bughunt-VIII-verified), the zero-ODE and power-sum laws, **the exact census semigroup** (the conjugated generator $T = 4y \partial_y^2 + 2\partial_y$ is degree-lowering, so $N_t = e^{-tT}N$ is a *finite exact sum* — closed form, no zeros, no ODE — with the leading coefficient A_0 -invariant and **the trace law** $\text{trace}(N_t) == \text{trace} + 2d(2d-1)t$ exact, measured deviation 0.0), **the generator split** ($-H''/H == -(H'/H)' - (H'/H)^2$; the linear half *is* the u^2 -atom re-weighting; the quadratic half has pair support disjoint from the atoms: **the missing half is exactly the RH-conditional pair class** — the flagged loop, not consumed), and the realness/KKL legs. Pinned: **theta-flow-inert** ($t_{\text{floor}} \geq 4021 \times$ the admissible window at every rung: H3 has no flow lever inside classical bounds); the wall fragility ladder (the wall margin dies 8–51 orders below the window); **the threefold-inequivalent dictionary** (sign pattern $(+, -, +)$ at every rung: “the flow” has no unique census meaning); flow-Z breaks the derived census nonnegativity in the realness-*granting* direction; **the λ_h criticality ladder** ($2.3898 \rightarrow 0.2161$, strictly decreasing toward the window scale, $43.4 \times \rightarrow 3.9 \times$ — the limit *open*, typed measured; honestly *not* an off-line-zero detector: the Epstein world measures *larger* backward slack); the witness is preserved-not-expelled (realness repair only at $10477 \times$ the window, inside the cited KKL ceiling). Not evidence for or against RH. Machine-checked: [verification/v938_dbn_heatflow_census.py]. [E] (the factor-4 lemma + the semigroup + the trace law + the generator split + the realness legs, exact) + [C] (the $t_{\text{floor}}/\lambda_h$ /fragility/dictionary/witness tables, typed measured) + [O] (the λ_h limit — open, typed)

Step-A exact and the CBJ adjudication (PRIME.CBJ.CONFLUENT.FRAME.01). One module (10/10). The round-180 family: the review’s externally proposed primary route (the cofinal-block-jet theorem via a confluent jet frame) fully instrumented. Recomputed in-run: **step A exact** — $F == \sum_k d_k \psi_k$ including $k = 0$ and $\delta_h == |J_h|_{G_h}^2$ with remainder $R == 0$, proven generically with the Gram PSD as an explicit sum of squares (the single most promotable theorem of the arc; certified numerically at all 14 reachable rungs, deviation $\leq 1.9 \times 10^{-46}$); **the cluster normal form** (the Cauchy basis-change determinant *is* the v922 spacing product; comb side $\det T == \prod (u_j - u_i) / \prod r!$); the window positivity (Fejér + Gauss exact); **the Montgomery–Vaughan pricing** (killed exactly at the contract’s linkage 1 ($1 - 3\pi < 0$); carrying at 3.15π with the *exact rational margin* $1/21$; the exact two-grid repair); the exact occupancy bound $m \leq \lfloor 2^{k+1}(e^w - 1) \rfloor + 1$; and the source-only selector $\hat{h}_k = 7/13/31/\dots/8191$ *recomputed in-run* (Bertrand-cofinal, SHA-sealed before any wall evaluation). Pinned: **the global form is dead at three independent measured walls** — the dof kill ($n = 474$ coefficients vs measured rank 128, dof 112.8; a depth- and zone-independent $c > 0$ cannot exist once $n > \text{dof}$), the seam coupling (0.994), the occupancy collapse (-0.7484 dex/atom) — while **the per-cluster floor carries** k -uniformly at fixed r (the wall is the r -collapse, not the depth); Gauss beats Fejér by 5–18 dex; the house Gram min-eig ladder $1.1 \times 10^{-17} \rightarrow 5.2 \times 10^{-113}$ (the round-175 conditioning wall in Gram coordinates); and the honest adverse selector finding: **underperforms the block average, clears the demand** (margins 2.14/3.05 at the selector rungs; all rungs ≥ 1.405 against the bar 1.35; no forall- k theorem claimed). CBJ delivers instruments and closes nothing. Not evidence for or against RH. Machine-checked: [verification/v939_cbj_frame_adjudication.py]. [E] (step A + the normal form + the MV margin $1/21$ + the occupancy bound + the selector recompute, exact) + [C] (the dof/seam/occupancy/support/selector/Gram tables, typed measured) + [O] (the r -collapse/jet convention, the Carleson tool — priced in v940 — and the house jet rescue, named open)

The sub-dof mass-fraction kill and the Carleson pricing (PRIME.CBJ.SUBDOF.BLOCKFLOOR.01). One module (9/9). The round-181 family: the blockwise sub-dof-scoped floor statement — what the program would actually need after the death of the global frame form — posed exactly, fully typed, and honestly *killed* at the decisive measurement. Recomputed in-run: the scoped chain (the PSD truncation and sufficiency exact on step A’s $R == 0$ base) and the fixed- r compactness sketch (the $m = 2$ full-merge limit $== \text{diag}(1, -\ddot{W}(0))$ exact: Gauss $\text{diag}(1, 1)$, Fejér $\text{diag}(1, 1/6)$ — the sympy-exact $1/6$, Bughunt-VIII-verified), plus the kill arithmetic: **the**

sub-dof mass fraction falls at +0.999 dex per rung (OLS slope recomputed from the pinned ladder) **and saturates at zero**; $\text{margin}_{\text{sub}}$ dies *at the selector rungs* (8.02×10^{-3} at $\hat{h}(B3) = 13$ — dead by factor ~ 125 , recomputed; the first drop below the bar is the B2 selector rung itself). The unscoped round-180 ladder (≥ 1.405 everywhere) remains the measured carrier: killed is the *proof route* through the well-conditioned subspace. **Carleson priced for the first time** (Bughunt-VIII web-verified): the box condition is equivalent to the *upper* inequality alone (Ortega-Cerdà-Seip, Ann. of Math. 155 (2002)) — wrong-direction for a floor — and every unconditional lower class misses for a named reason, with the Nazarov–Turán constant $(C|I|/|E|)^{n-1}$ *exponential in the term count*: the classical mirror of the measured occupancy law; a 23-dex two-sided gap stays open in the depth. **Fraction-world-separating** (the SF6 anatomy sharpened): the floor *value* is world-insensitive but the mass *location* separates worlds — only the arithmetic world rides the ill-conditioned tail (MAIN tails $-4.11/-2.26/-0.04$ vs fakes $-11.7..-14.3$); the first measured world separator not sitting at the bridge. Not evidence for or against RH. Machine-checked: [verification/v940_cbj_subdof_blockfloor.py]. [E] (the chain legs + the compactness anchor with the exact $1/6$ + the slope/factor arithmetic, recomputed in-run) + [C] (the tail/margin/resonance/Carleson/separator tables, typed measured or cited-priced) + [O] (the needed jet constant — now priced, open)

The frozen alignment law and its factorization (PRIME.ALIGNMENT.LAW.01). One module (11/11). The round-182 family: the sharpest unexplained regularity of the program — the distribution of the source-jet projections $s_i = v_i \cdot J_n$ over the house-Gram spectrum — precisely measured, frozen and mechanism-factorized (not derived, honestly typed). Recomputed in-run: **Gram-source-free** (the Gram kernel carries no source symbol — the entire law lives in the source ray d against fixed geometry; proven three ways in the probe), **the key adjudication** ($s_i A_0 == \langle v_i, Dd \rangle / \sqrt{S_\mu}$ is *linear* in d and every mass fraction is scale-invariant: **the location law is projective and A_0 -free** — the round-178 eigenvector-map obstruction does *not* bite between d and the law), the exact norms-do-not-force-location exhibit, and **the one shared nonlinear link** (the wall eigenmap, $\lambda_{\min}(A+B) = -\sqrt{2}$ re-exhibited: the law is exactly as bridge-expressible as δ itself, Landau class per census *given* d). Pinned: **the frozen triple** — the half-power envelope (α inside (0.38, 0.54) at all 14 rungs; per Bughunt-VIII F4 a *measured-descriptive* band, never a prediction), the quarter-depth wall lock ($\mu_m = 0.2372 \log_{10} g_{\min}$, R^2 0.9916; -2.41 dex/rung, R^2 0.9962), and the deep excess (5.64–7.58 dex at $h \geq 8$ — *exactly the round-181 kill mass*); the round-177 gap ladder replicates exactly (one object, two currencies — measured correlation, not identity); **alt-jets-break-alignment** (every deterministic deformation of the true ray snaps the mass to the top: the law needs the joint exact sign-and-magnitude structure of d); **witness-breaks-alignment** (relative source cost $5.3 \times 10^{-7}/8.2 \times 10^{-14}$); the naive power composition is invalid (overshoots 3.41/10.14 dex, disclosed) — the honest composed floor is the measured level itself. The terminal adjudication carries the Bughunt-VIII F1 *corrected* wording: **same-class-not-new-edge** — the floor form needs a lower bound on $|N_i(d)|/|A_0(d)|$, the same variational-quotient *class* as θ_∞ and H-pin Omega-a (four distinct formal statements over the same source object, the wall argmin ray d , in A_0 -quotient form); *no* new residue edge, because the floor route is optional and machine-excluded from the delivered set — not because the objects are identical. Not evidence for or against RH. Machine-checked: [verification/v941_alignment_law_factorization.py]. [E] (Gram source-freedom + projective linearity + the exhibits + the factorization, exact) + [C] (the envelope/lock/excess/ dissection/witness tables, typed measured-descriptive) + [O] (the level leg — the known variational-quotient wall, open, typed)

The detector-specificity theorem (PI.PATTERN.SCAN.01). One module (9/9). The round-184 family: the prime-front instruments transferred unchanged in structure to pi-derived data under full house discipline — **an instrument characterization, not arithmetic novelty**. The specificity null: all five predefined pi worlds (digit combs, continued fraction, BBP, convergent-geometric) classify **top-heavy** ($\log_{10}$ tails $-10.0..-17.9$) exactly like the fake-world class, on both holdout halves, all rungs, all 100 non-Mangoldt instances — zero anomalies. **Transfer validity proven** (the load-bearing methodology of the whole rounds-184–191 mechanism arc): the C-MANGOLDT

positive control fires on every transferred detector (port dev 8.4×10^{-59} ; spike $C = 131.04$ vs the integer-position-matched null max 12.60; the alt-jet battery replicates round 182); the structured controls prove the detectors *can* fire (Champernowne Weyl 15.8/43.2 vs null 2.46; φ GK χ^2 7047); pi's classical CF laws replicate as measured expectations. Recomputed in-run: the Gauss–Kuzmin telescoping sum $== 1$ (exact), the Lévy and Khinchin constants, the BBP series $== \pi$ (30 digits), the bar arithmetic. The Bughunt-IX K3 correction adopted: the smoke lineage disclosed (a pre-freeze OverflowError crash smoke on the Liouville CF stream; no record impact); P-BBP carries the in-spec PROVISIONAL flag. No pi-numerology claim. Not evidence for or against RH. Machine-checked: [verification/v942_pi_pattern_transfer_specificity.py]. [E] (the classical-law exact layer, recomputed in-run) + [C] (the port/anchor/ladder/null tables, per record, typed measured)

The zero-coupled sharp localization (PRIME.MANGOLDT.ABLATION.01). One module (8/8). The round-185 family: the causal question from round 184 answered with a sharp mechanistic localization — **both arithmetic signatures are zero-coupled explicit-formula phenomena**. The additive property ladder (W0 random $\rightarrow$ W1 Cramér density $\rightarrow$ W2 +log-weights $\rightarrow$ W3 +power grammar $\rightarrow$ W4 +full Beurling multiplicativity $\rightarrow$ W5 true Mangoldt) switches both signatures on **only at W5 and sharply** (S1 jump 12.07 dex, S2 jump 61 $\times$); the Beurling headline answer is a definitive **no** — multiplicativity without Riemann-zero coupling produces neither signature. Necessity: every ablation kills its property (A1 $-$ powers kills S1 while S2 survives at 129.06 — S2 sits on the exact prime *positions*); even ± 0.01 position jitter kills both. W5 replicates round 184 (transfer valid). Recomputed in-run: $\psi(n) == \log \text{lcm}(1..n)$ exact at $n = 30$; the Cramér $n = 2$ clamp; the classification and jump arithmetic. The single 26/27 FAIL is the *disclosed* control-side Beurling density band (5.74 vs $[0.2, 5.0]$) — Bughunt-IX-adjudicated an honest Poisson fluctuation, density-correct, the W4 headline unweakened. A mechanism characterization, not arithmetic novelty; no claim about where the true zeros lie. Not evidence for or against RH. Machine-checked: [verification/v943_mangoldt_ablation_localization.py]. [E] (the grammar/clamp exact layer, recomputed in-run) + [C] (the ladder/jump/ablation/jitter tables, per record, typed measured; the one disclosed control-side FAIL adjudicated honest)

The exact residue identity and the Feshbach scalar form (PRIME.GROUND.RESIDUE.OBS.01). One module (11/11). The round-186 family: the H3/ A_0 -floor leg of the terminal residue put into **eigenvector-free coordinates at identity level**. Recomputed in-run (exact): $\text{Res}_{z=\tau} l^T(zI - M)^{-1}l == (l \cdot d)^2 / \|d\|^2$ (generic 2×2 + the quaternion rational-orthogonal 3×3); the Feshbach/Schur form $R(z) == \|l\|^2 / w(z)$ with $A_0^2 w'(\tau) == \|l\|^2$ and $w'(\tau) == 1 + m^T(\tau I - B)^{-2}m$; the CDLI adjugate tie $A_0^2 == N(\tau)/P'(\tau)$ (same identity, new coordinates — disclosed prior art); **strict interlacing** $\Leftrightarrow A_0 \neq 0$, both directions; the exact A_0 -null $\sum_{k=0}^{41} (-1)^k == 0$; the displacement algebra (diagonal-blind). Probe: the identity gated $\leq 7.8 \times 10^{-45}$ at all 14 rungs; the key answer in two halves — (yes) $w'(\tau)$ computes eigenvector-free from $\{\alpha, m, B\}$ plus the one measured scalar τ (per the Bughunt-IX K4 glossary: *source-side (eigenvector-free, given τ)*); (but) **eigenvector-descends-not-eliminated** — the demand concentrates on the compression ground overlap, $\|m\|$ -pricing loses 11.2–90.7 orders, no floor claimed; **gap-is-residue-in-disguise** ($\varepsilon \leq 2.55 \times 10^{-6}$: the transversality gap is the residue in matrix coordinates, not an independent handle); the raw-gap floor leg rides τ (+1.011) and is relabeled-and-stopped; the values separate worlds ≥ 1 dex (measured); the $\{l_0, l_2\}$ residue pair detects the witness at $\sim W^2$ while l_0 stays blind (disclosed). **The Bughunt-IX K1 (major) corrected wording adopted verbatim:** the off-diagonal of the raw wall is exactly the divided-difference form of *one* source function (displacement rank 2 fixes *only* the off-diagonal); the full wall is $M_h \sim L_f + \text{diag}(\Delta)$ with source-side $\Delta \neq 0$ — *not* the canonical Loewner matrix of the Loewner-1934 dictionary, and $R_h(z)$ is the resolvent of $L_f + \text{diag}(\Delta)$, not of the Loewner kernel alone. Not evidence for or against RH. Machine-checked: [verification/v944_ground_residue_observability.py]. [E] (the residue/Feshbach/CDLI/interlacing/displacement layer, exact, recomputed in-run) + [C] (the gap/overlap/margin/ witness/alt-jet ladders, typed measured) + [O] (the lambda-uniform gap floor — named as the open input, not claimed)

The causal zero-coupling demonstration with its stratification (PRIME.ZERO.CAUSAL.SYNTH.01 + PRIME.ZB.WIGGLE.STRAT.01). One *joint* module (10/10; round 190 upgrades round 187 *by reference*, house style — the r187 record itself stays PARTIAL, unedited). The inverse experiment: comb worlds with **controlled zero spectra**, synthesized through the round-175 mode-level explicit-formula bridge run backwards, and the S2 signature moves **causally** with the zeros — a mechanism demonstration on controlled synthetic worlds, not arithmetic novelty. Z0 validity 0.0006 on $C = 131.04$ (the engine is valid; the S1 eigen-readout died *exactly as the frozen round-175 conditioning-wall prediction said* — honest instrument death, disclosed; the two 31/33 FAILs are these disclosed adjudication gates). The off-line dose surface: monotone in δ everywhere (response up to $\text{DEV} = 25.8$; first response $(0.10, 10^{-2})$; first death $(0.05, 10^{-4})$). **Exact-ordinates-required:** Poisson and GUE ordinate-resamples at the true density both die. The stratification (round 190; the Bughunt-IX K2 corrected figure adopted): the wiggle in full precision is $W_{\text{rec}} = 1.065464$ — **reads 1.07, never 1.14** — real ($1.0655 > \text{slack } 1.0$) but deep inside every matched-dose selection spread ($5.09/3.07/3.98$); dose monotone in expectation (26.96 vs 9.18); the inversion generic subset-overshoot (INV-FRAC 1.00); the per-zero leverage ladder measured ($\gamma_2 = 21.02$ carries the most, no first-zero dominance, the 10-set strongly subadditive); depth parity not an artifact. Recomputed in-run: the general- ρ mode term reduces exactly on-line at $\beta = 1/2$; the dose law $|x^\rho| = x^\beta$; the K2/noise/subadditivity arithmetic. The round-185 interpretation upgrades to **demonstrated mechanism on the S2 channel**; the zero cache is control-construction data (Epstein class), never a hypothesis. **Still no claim about where the true zeros lie.** Not evidence for or against RH. Machine-checked: `[verification/v945_zero_causal_stratification.py]`. **[E]** (the general- ρ /dose-law algebra + the stratification arithmetic, exact, recomputed in-run) + **[C]** (the Z0/dose/resample/leverage/depth tables, per record, typed measured; the two disclosed adjudication FAILs typed honest)

The exact Krein pencil (PRIME.CENSUS.SPECTRAL.LIFT.01). One module (8/8). The round-188 family: Spur 1 of the review plan closed as an honest **partial lift** with a real structural theorem — the census polynomial (always the finite root set of $N_h(y)$, never a zeta zero set) *is* the spectral determinant of a source-side self-adjoint pencil, but of a **Krein (indefinite-metric) pencil** at every true rung: $N_h(y) = (-1)^{K-1} \det(J) A_0 \det(\hat{A} - yJ)$ with $\hat{A} = JD - (Jw)(Jw)^T$, $J = \text{diag}(\text{sign } \rho_k)$, and $\sum_k \rho_k = -y_t$ exactly (the v924 moment-Laurent -1 source-side). The decisive number: the residue-sign ladder $(n_+, n_-) = (1, 5)/(7, 3)/(6, 14)/(27, 14)/(45, 34)/(43, 73)$ — mixed at every true rung, so realness (H2) is *not* delivered structurally: **it is equivalent to Krein strong definitizability** (the operator-form coordinate); the smooth world is one-signed $(0, 10)$ while the scrambled and Epstein worlds are just as mixed as the true one: **mixedness-is-arithmetic** (atoms-vs-no-atoms, the wrong orientation for a sign source, explicitly not one); **mixedness is transform-invariant** in the predefined class (Möbius / positive weight / $y \rightarrow g^2$, lemmas recomputed symbolically in-run: definite impossible *in class*). Recomputed in-run (exact): the matrix determinant lemma, the full Krein assembly over all sign patterns, and the E1/E2 identity chain on an exact rational instance (probe: dyadic-exact E1 at all six rungs, integer-Bareiss E2 at $h \leq 13$, typed MDL-EXACT-H13-NUMERIC-H2128, disclosed). The bracket certified via ENVJ ($c^* = 1.10/1.15$) *without computing a single root*; roots never consumed (machine-audited); tau-free; the named $W(y) > 0$ upgrade path subsequently **closed by theorem** (v948). Not evidence for or against RH. Machine-checked: `[verification/v946_census_krein_pencil.py]`. **[E]** (the MDL/assembly/transform lemmas + the E1/E2 chain, exact, recomputed in-run) + **[C]** (the six-rung ladders and ENVJ tables, per record, typed measured) + **[O]** (H2 in operator form — Krein definitizability, open, typed)

The exact Loewner–Pick dictionary and the Pick-class refutation (PRIME.LOEWNER.PICK.01). One module (9/9). The round-189 family: Loewner’s theorem adjudicated as a currency for wall positivity — the Pick reading **refuted with margins**, and an exact new structural law in its place. The dictionary: $M_h \text{ PSD} \Leftrightarrow \text{Raw}_h \text{ PSD}$ by exact Sylvester congruence, and $\text{Raw}_h = L_f + \text{diag}(\Delta)$ — a **diagonally-shifted** one-function Loewner matrix, not the canonical object of Loewner 1934 / Donoghue 1974 / Simon 2019. **The new exact law** (sympy per-

atom + mp $\leq 6.0 \times 10^{-61}$; Bughunt-IX own recompute $\leq 6.3 \times 10^{-61}$): the prime-block diagonal shift is $\text{Raw}[k, k] - f'_{\text{prime}}(b_k) = 2a \text{pc}_k$ — **the cosine quadrature of the same sieve atoms** whose sine quadrature feeds the potential: the wall carries both quadratures in different slots. Recomputed in-run (exact): the pole block fully canonical ($\Delta_{\text{pole}} == 0$ identically; divided difference $==$ rank-1 Cauchy); f_{pole} a genuine Pick function with **exact Herglotz point mass** $2 \sinh^2(a/2) \delta_{-1/4}$; the per-atom chain rule; the commensurate-sampling mechanism $\sin(2a \omega_k) == 0$ at the nodes (**smooth-PSD-at-nodes** — lattice geometry, not a prime fingerprint). The refutation (pinned): $\lambda_{\min}(L_f) < 0$ at all 14 rungs — the Pick costume misses wall positivity by 9.4–87.9 orders; order-1 already dead (descent counts 2–34); all grid sign changes carried by the prime leg; refinement *deepens*; the 17-node window order-separation exhibit. Herglotz per leg: pole exact, arch open (honestly no closed form), prime leg the named relabeling *barrier* (a positive rewrite would be the wall positivity itself). Tau-screens both flat; the r45 LOEWNER-DEAD distinction carried (a *third* reading killed; the IIKS/RHP lane untouched). Not evidence for or against RH. Machine-checked: [verification/v947_loewner_pick_dictionary.py]. [E] (the pole-canoncity/Pick/Herglotz/commensurability algebra, exact, recomputed in-run; the cosine law probe-proven per-atom) + [C] (the $\lambda_{\min}$ /descent/grid/window/world tables, per record, typed measured) + [O] (the arch-leg representation — open, typed)

The sign-characteristic law and the congruence-class kill (PRIME.KREIN.DEFINITIZER.01). One module (10/10). The round-191 family: the round-188 upgrade path **closed by theorem, not by search**, with two genuine new objects. The classical dictionary imported precisely (Langer 1982; Zizler 1995 via Lancaster–Ye 1993; Gohberg–Lancaster–Rodman 2005): finite-dimensional Langer definitizability is *degenerate* (Cayley–Hamilton, exhibited in-run); the non-vacuous notion is **strong** definitizability, equivalent to H2 per rung. The exact law (recomputed in-run): the kernel vector at a census root is explicit, $\varepsilon_i = -\text{sign}((F/A_0)'(y_i))$, with the combinatorial formula, the flip law, and **the count law** $\#\varepsilon_{\pm} = n_{\pm}$ **exactly: the round-188 residue ladder is the Krein sign-characteristic multiset** — two-route proven in the module on the full 32-cell exact Sturm battery (no floats) and in the probe at every measured rung. **The parity scaffold** (the new source-side coordinate; per the K4 glossary *source-side (root-free)*): root-count parity per pole gap from residue signs alone, verified at all 81 gaps. **The $W(y)$ -congruence-class kill**: for any smooth invertible $W(y)$ the crossing form is congruence- invariant (the W' terms die on the kernel, proven generically in-run), so the measured mixed ladder kills the *entire* $W(y) > 0$ class at once — **impossible-in-class**, with the remaining doors named honestly (dimension-enlarging linearizations trivial-by-roots hence forbidden; residue-sign- changing non-congruence transforms currently an empty class). The strict definitizer is **root-dependent** (occupancy-minimality fails at $h = 8, 13$ by exactly one interior doubled gap); the r172 witness **breaks census realness** while the raw ladder stays blind — a new detector; orientation stays atoms-vs-no-atoms; tau-flat; the Krein coordinate closed STRUCTURAL-ONLY (the reformulation adds no leverage). Not evidence for or against RH. Machine-checked: [verification/v948_krein_sign_characteristic.py]. [E] (the kernel/Weyl identity, the two-route/flip/count laws on the exact battery, the parity scaffold, the congruence lemma, the CH degeneracy — exact, recomputed in-run) + [C] (the d_h /occupancy/family/witness/world tables, per record, typed measured) + [O] (H2-cofinal in operator form $==$ realness — open, typed)

The exact node mechanism and the Baker-class pricing (PRIME.COMMENSURABILITY.MECHANISM.01). One module (11/11). The round-192 family: the thin geometric hope “incommensurability feeds wall positivity” **cleanly killed at the margin**, with an exact mechanism statement for the canonical completion in its place. Recomputed in-run (exact): the node-lattice identities $\sin(2a \omega_k) == 0$ *plus* the boundary-phase invisibility $\sin(2a \omega_k \pm \omega_k u) == \pm \sin(\omega_k u)$; **the smooth collapse to Möbius data** ($\text{pj}_s(\omega_k) = \omega_k(1 - e^a)/(1/4 + b_k)$, $\text{pc}_s(\omega_k) = (e^a - 1)/(2(1/4 + b_k))$), and the combined node potential $2(1 - e^a) + (1 - e^{-a})/2/(1/4 + b)$ — the exact content of the v947 SMOOTH-PSD-AT-NODES finding); **the structural-zero census** in exact integers ($h = 4$: 12/18, $h = 8$: 32/120 — the $e \mid 2fk$ law; the Bughunt-X KE wording adopted: the probe’s symbolic leg was vacuous, the law’s machine content lives in the census gates and reproduces exactly); the Jordan bridge $\sin(\pi x) \geq 2x$ (concavity, exact); and **the first Baker-class pricing in the program’s**

history, recomputed from the published constants at the $h = 4$ minimizer — exact-integer independence $3^{10} \neq 4^8$, Liouville gap 3.79 dex, Laurent–Mignotte–Nesterenko 1995 gap 7.099×10^3 dex, Matveev 2000 gap 1.682×10^9 dex: **Baker-too-weak** (full ladders pinned: LMN 7.10^{+3} – 3.10^{+4} , Matveev 1.36^{+9} – 1.18^{+10} dex; genuine unconditional non-zeta arithmetic, honestly useless at these scales). The verdict (outcome c): **positivity-irrelevant-exactness-kill** — the defect ladder is $O(1)$ -flat while τ falls 45 orders, the dose is **direction-blind** (killed both ways at every dose rung + jitter; COMM-WALL-DEAD), and $L_f(t = 1)$ is PSD at all four dose rungs **world-blind**: lattice geometry, not a prime fingerprint. The margin consumes position *exactness*, not incommensurability magnitude — the sought source functional must consume the exact positions wholesale. Not evidence for or against RH. Machine-checked: [verification/v949_commensurability_mechanism.py]. [E] (the node/collapse/census/Jordan algebra + the published bound formulas, exact, recomputed in-run) + [C] (the defect/dose/world ladders, per record, typed measured)

The zero-comb channel characterization (PRIME.ZERO.CHANNEL.CAPACITY.01). One module (8/8). The round-194 family: the r187/r190 (v945) write→read arc characterized as a **channel**, information-theoretically, everything predefined — typed **exploratory instrument characterization** at discovery and promoted as exactly that: *no storage claim, no arithmetic-novelty claim*. The capacity surface (pinned): median-band MI (bits, Miller–Madow) LOW 0.083/0.368/1.595/1.606 and MID 0.050/0.347/1.165/1.579 over $\varepsilon = 0.001/0.003/0.01/0.03$ — **error-free full ternary capacity** ($\log_2 3$) from $\varepsilon = 0.01$. The resolution limit: LOW = 0.001, MID = 0.003 — below the r187 resonance scale, **with the Bughunt-X F6 quantification adopted**: the LOW call has $P = 0.0032$ under the 20000-trial null Monte Carlo — *marginal-but-nonnull* single-reading, decisive with averaging (MI $0.042 \rightarrow 0.257 \rightarrow 0.938$ over $n_{\text{read}} = 1/4/16$); the sqrt- n prediction held ($0.2325 \in [0.15, 0.42]$). **Linearity-scale 0.01**: a linear codec below, INTERFERENCE-MEMORY above (far more linear than the off-line channel: $+0.0139$ vs $+5.32$). **Parity-erasure recovery 1.000** (bar 0.5375, recomputed in-run) — added redundancy survives end-to-end; **the F7 corollary typing adopted**: the 1.000 is a corollary of the zero-symbol-error cell, not independent evidence. Recomputed in-run: the capacity ceiling, the erasure bar, the Miller–Madow excess bound, and **the 108-case parity-code erasure theorem** (exact mod-3). P3 refuted and disclosed (CHANNEL-GAIN-LOW>MID, ratio 0.508); controls clean; the round-107 code-reading verdict cited, *not* upgraded. Not evidence for or against RH. Machine-checked: [verification/v950_zero_channel_capacity.py]. [E] (the code algebra, exact, recomputed in-run) + [C] (the capacity/NL/erasure/gain/control tables, per record, typed measured; instrument characterization — no storage claim)

The cancellation functional: the ACF law, the pole square and the arch law (PRIME.CANCELLATION.FUNCTIONAL.01). One module (10/10). The round-195 family — the arc’s single most promotable round: **the wall is a closed truncated Weil-explicit-formula functional** of the positive-definite test function g_x . **The ACF law** (recomputed in-run: the generic convolution identity by explicit warded antiderivative; the $k = 0$ wraparound slice; the full kernel-vs-quadrature ward at every atom of $h = 4, 5$ on an own wall build): an atom’s total wall contribution is one kernel with $x^T W(u) x = -2 \int_0^{L-u} A_x(t) A_x(t+u) dt$ — *minus twice the aperiodic autocorrelation* of the windowed mode polynomial at lag $\log q$; the v947 “two quadrature slots” are **one object**. **The pole square** $x^T \text{RawP} x = 8 \sinh^2(a/2) (\int_0^\infty e^{-t/2} A_x)^2$ (sympy generic + numeric): a manifest L^2 square. **The arch law** $\Delta \text{Arch}_k = -\text{mult}_k L(\kappa(\omega_k) + c^*)$ with $c^* = (\gamma + \ln 2\pi)/2$ *exactly*, recomputed at every mode of $h = 4, 5$. **The Bughunt-X KD pin, recomputed in-run — the arc’s external handoff object**: $\kappa(\omega) + c^* \rightarrow -\frac{1}{2}[\text{Re} \psi(1/4 + i\omega/2) - \ln \pi]$ in the $L \rightarrow \infty$ limit (verified at $L = 80$; BH10 own verification 6×10^{-18}) — *the arch kernel is the classical Weil archimedean kernel in the window limit*, with the finite- L corrections $O(e^{-L/2})$ typed not-small. **Per-atom manifest positivity is provably impossible** (Wiener–Khinchin: each atom samples a PD function with a minus sign; $x = e_0$ exhibit exact). The measured anatomy (pinned): **the pole alone carries positivity** ($P = 1.281 \rightarrow 2.632 > 0$, arch and prime negative); depth == the τ ladder (definitional); **the sign law** ($n_+ = 0$ at all 14 rungs, the $q = h$ atom exactly zero, $m_{99} = 1..2$: compensation is *atoms-vs-pole*, not atom-vs-atom). Honest pricing adopted verbatim: **an algebraic restatement** — the relabeling barrier named, not crossed; WEIL-ALLTESTS $\leftrightarrow$

RH a flagged loop consumed by nothing. Not evidence for or against RH. Machine-checked: [verification/v951_cancellation_functional.py]. [E] (the convolution/Laplace/arch algebra + the $h = 4, 5$ laws + the KD digamma limit, recomputed in-run) + [C] (the anatomy/sign/world tables, per record, typed measured)

The Turán extremal pricing (PRIME.TURAN.EXTREMAL.01). One module (9/9). The round-196 family: the classical Turán/Boas–Kac/Fejér PD-cone theory imported with exact citations and **priced against the wall for the first time in 196 rounds**, two-sided. Recomputed in-run (exact): **the Fejér coefficient theorem at $n = 1, 2$** — extremal construction attains $\cos(\pi/(n+2))$ as a manifest square, optimality by *single-node dual certificates* (the Bughunt-X independent route), both tight; the signed-bound flip; **the KB rational-lag identity** (Bughunt-X F2 adopted): at $u = L/2$ the off-diagonal of $W(L/2)$ vanishes *identically* and $M_{\text{sub}}(L/2) == 1/2 == \cos(\pi/3) == M_{\text{KR}}(L/2)$ exactly — **the Fejér extremal lifts exactly into the mode lattice at rational lags only**, near-attainment elsewhere (the own-log 4.1×10^{-4} deficit at $h = 5$, inside the 0.30 dex enum bar; the “f64 precision” wording retired); the edge kill $W(L) == 0$ identically; the subcone *contains* the Turán interval extremal ($x = e_0$ the Fejér triangle, equality — Siegel 1935/Boas–Kac). The decisive ladder (pinned): **every cone bound is negative at every rung** while the truth is τ -deep positive — cone geometry cannot see positivity; the cone-vs-truth gap is the τ ladder (gapdex 11.35 $\rightarrow$ 89.03, slope -1.007 at R^2 1.000): TURAN-BUDGET-TAU-GAP, the relabeling barrier named *at the cone level* with the exact dex table. **The counter-finding** (the round’s real news): CONE-DRAIN-01-CAPTURE — capture 0.14–0.24 dex flat: the classical Fejér cap describes the wall’s drain capacity almost exactly; Q2-NEAR-TIGHT (1.09–1.23); the arch leg does not classicalize (ARCH-LEG-SUBCONE-ONLY, named). The TURAN-CONE-POSITIVITY $\leftrightarrow$ WEIL-ALLTESTS loop is flagged and consumed by nothing. Not evidence for or against RH. Machine-checked: [verification/v952_turan_extremal.py]. [E] (the Fejér construction + dual certificates, the rational-lag identity, the edge kill, the subcone exhibit — exact, recomputed in-run) + [C] (the gapdex/capture/q2dex/ world ladders, per record, typed measured)

$A_{v_0} \geq 0$: the nonnegativity theorem with the Sturm continuum certificates (PRIME.FEWATOM.REDUCTION.01). One module (10/10). The round-197 family *plus the Bughunt-X mathematical deliverable folded in*: the collapsing direction’s mode polynomial $A_{v_0}(t)$ is **nonnegative on $[0, L]$ at all 14 rungs** — a nodeless positive bump peaked exactly at $L/2$ whose edge-minimum ladder *is* the jr_0 ladder. **The KA scope rider travels verbatim on every surface carrying this headline**: the r197 gate class is GRID-MEASURED ($N = 16K$ grid, zero-class bar 10^{-30} ; at $h = 15/16/20$ the record minimum sits *below* the bar’s resolution — print evidence, not gate certificate); **the headline is true and now stronger**: continuum nonnegativity is **certified by exact-rational Sturm chains** at $h = 4, 5$ (exact Fractions) and $h = 13, 20$ (rounded coefficients with strict subtracted floors) by Bughunt X, with jr_0 re-verified at $h = 20$ at dps 170. **This module recomputes the $h = 4, 5$ certificates**: own wall build, mp inverse iteration, exact dyadic Fractions, the Chebyshev conversion $A(t) = P(\cos(2\pi t/L))$ and the *integer primitive-PRS Sturm chain* — zero roots in $(-1, 1]$, $P(\pm 1) > 0$: $A_{v_0} > 0$ on *all* of $[0, L]$, no floats. **The one-line mechanism**: $A \geq 0 \Rightarrow$ every ACF sample $g(u) \geq 0 \Rightarrow$ every atom negative — the v951 sign law reduced (exhibited in-run; the $q = h$ atom exactly zero); the budget resplit and the horizon $Q_{99} = (1, q = 2)$ recomputed at both rungs. The KC rider adopted: the edge minimum *is* A_0 **un-normalized** (verified exact); the r197/r198 pair consistent. The ladders (pinned): HORIZON-BOUNDED- $\{2, 3\}$ incl. the holdout — *with the mandatory scale-relativity rider*: at the demand scale the horizon consumes *every* resolvable atom (NOT-A-COMPLEXITY-DROP-IN-H; any lossy tail bound is certification-dead); decay edge-power, *not* universal (P3 refuted; the jet-convolution law band-approximate — the r182/v941 alignment in ACF coordinates); the shape mechanism Epstein-separating; the witness flattens the ACF ladder. **Object-A** (the Bughunt-X X6 targeting result): “prove $A_{v_0(h)} \geq 0$ for all h ” is *the one genuinely new tractable target* of the arc — $v_0(h)$ -quantified, yields the sign law only, **no lever on wall positivity**. Not evidence for or against RH. Machine-checked: [verification/v953_fewatom_reduction.py]. [E] (the $h = 4, 5$ Sturm continuum certificates, the one-line mechanism, the budget resplit, the KC identification — exact, recomputed

in-run) + [C] (the nonneg/horizon/decay/world ladders, per record, GRID-MEASURED per KA) + [O] (Object-A for all h — open, typed)

The Perron–Frobenius adjudication (PRIME.NODELESS.PF.01). One module (10/10). The round-198 family: the r197 candidate route for Object-A **fully adjudicated — dead in the mode basis**, with the obstruction localized exactly and a surviving Z-structure. Recomputed in-run: **the trivial-route exhibit** ($v = e_1$: nonnegative coefficients yet $A(L/2) = -1$ exactly — coefficient one-signedness would prove the *wrong* statement’s sign pattern); the pole off-diagonal rank-1-Cauchy positivity (exact); **the off-diagonal censuses at $h = 4, 5$ matching the record exactly** ($(n_+, n_-) = (15, 6)/(38, 17)$, checkerboard-mixed in both parities: OFF-DIAG-MIXED-PF-MODE-DEAD); the cross-gate nflip == raw_{nn} (every negative off-diagonal is a *prime-dominated* pair; fracdom 0.524/0.509); v0-PARITY-BROKEN recomputed (mis = 2/4; the misaligned mass flat, not a τ ladder); the pole kernel factor $\varphi > 0$ on the whole 33-lattice; and **the cone tests at $h = 4$: the wall operator violates cone invariance on 11..14 of 20 Fejér family members while the no-pole operator has zero violations — KR-WALL-CONE-FAILS-POLE-IS-THE-OBSTRUCTION: the operator piece that fails the nonnegative-function cone is exactly the rank-one piece that carries the positivity** (the v951 pole-vs-atoms compensation as cone-geometry tension). The surviving structure (pinned): KERNEL-SPLIT-POLE-POSITIVE-HOPPING-Z — the pole kernel negfrac 0.000 exactly, arch 0.955..0.989, prime 0.973..1.000: the attractive-hopping Z-structure survives the band projection on prime + arch, and the wall’s kernel mixing is *entirely* the pole-vs-hopping competition. SMOOTH is the structural outlier (all-positive off-diagonals, cone-preserving, keeps nonnegativity with *no* Z-structure); EPSTEIN breaks the shape with all-positive weights ($hd = 0$ single-cell separation, recorded not sold). The chain: CHAIN-OPEN-FUNCTION-SPACE — Object-A stays open, genuinely function-space (the r197/r198 pair consistent per KC); the X6 discipline: “pole-vs-hopping balance” is the *class name* of Object-W (wall positivity itself), not a new attack object. Not evidence for or against RH. Machine-checked: [verification/v954_nodeless_pf.py]. [E] (the trivial-route exhibit, the pole Cauchy law, the exact censuses/cross-gates/cone tests at $h = 4$ (5) — recomputed in-run) + [C] (the kernel/world/witness ladders, per record, typed measured) + [O] (Object-A — open, function-space, typed)

The finite integrable dictionary (PRIME.PORT.TAU.FINITE.IIKS.01). One module from three frozen probes (rounds 224–226, 18/18 + 15/15 + 17/17 first pass, embedded byte-exact). **The tau identification executed (TAU-IIKS-EXACT):** the wall determinant is the exact IIKS Fredholm tau function at the finite-identity level — Sylvester as a full characteristic identity on the whole s -grid, the s -dressed Schur family $\det(I - sE) = \det(I - sR) \det(I - sD_P(s))$ exact (the fixed-kernel alias named and blocked), the confluent diagonal ($\leq 3.2 \times 10^{-13}$), the IIKS dressing identity ($\leq 7.9 \times 10^{-13}$) with the dressed port generators source-explicit in closed form, the Fredholm/JMU variational identity in two independent times, the relative tau transfer exact over $-212.84/-195.50$ log-unit collapses. **The Lax degree adjudicated (LAX1-H-EXACT):** the h -step exactly rank one, the degree-1 source-chain connection blind-predictive ($3.4 \times 10^{-16} / 3.2 \times 10^{-11}$), zero curvature identically world-blind; the s -time has no fixed degree and across rungs no common carrier — typed. **The Toda dictionary (HIROTA-TODA-EXACT + WALL-EQUIVALENT):** $\tau_{w,n} = D_n(\mu - \nu)/D_n(\mu)$, $r_n = h_n(\mu - \nu)/h_n(\mu)$, the Hirota coefficient source-pure from a scaled signed Stieltjes recursion; its positivity $\iff$ quasi-definiteness of the signed defect measure $\mu - \nu \iff$ the wall (the explicit SIGNED-TODA $X - Y$ structure); MAIN carries all 184 $r_n > 0$, the controls flip at $n = 25/21/27$. The claim splitting of note DLI carried: the sign question stands alone as PRIME.PORT.TAU.NOPOLE.COFINAL.01 [O]; the v883 umbrella PRIME.PORT.TAU.01 stays [O] for the fully symbolic arbitrary- h statement. Not evidence for or against RH. Machine-checked: [verification/v955_tau_iiks_toda_dictionary.py]. [E] (the Sylvester/Schur/confluence/dressing/Fredholm/transfer identities, the rank-1 step and degree-1 connection, the Toda dictionary — exact on the true builders, world-blind) + [C] (the sign/flip ladders and blind predictions, per record) + [O] (the tau sign $\tau_h(1) > 0$ cofinal — open, typed)

The half-filling geometry (PRIME.FREEMOMENT.JFRACTION.01 + PRIME.JACOBI.DUAL.REVERSAL.01). One module from four frozen probes (rounds 228–231, 14/14 + 17/17 + 17/17 + 13/13

first pass, embedded byte-exact). **The half-filling law:** $N_w = \lceil \# \text{supp}(\tilde{\mu})/2 \rceil$ exact on all five windows — the window cap is the half-filling of the union support, and past the cap the wall dies immediately (first r -flip at $N_w + 0/2/2/3/1$, $O(1)$ offsets): $\mu - \nu$ is quasi-definite exactly up to half-filling — *the wall is maximal*; the complement identity and h -duality exact at dps 80. **The free moment window law:** both signature predictions refuted; the largest Hankel window inside the S free moments is $n = (S + 1)/2 = N_w$ — MAIN exhausts the *entire* free moment window while the controls die at 11–15% of it; the inertia theorem exact in all parts; at window degree the wall family is the same evaluation contractor with $\lambda_{\max}(Q_{N_w}) < 1$ (SAME-CONTRACTOR-EXACT — the v881 testing law closes the circle). **The four-path dictionary:** moment prefix = Jacobi chain = Euclidean chain = value chain (exact in rationals; the offsets are forced-coupling survival counts; Epstein’s first wrong Euclidean pivot exactly at its flip $n = 25$). **The reversal and the connection theorem:** the dual signed measure carries the mirrored Jacobi chain ($\alpha_m^\# = \alpha_{S-1-m}$, $\beta_m^\# = \beta_{S-m}$) but is not a builder transformation (NO-SOURCE-REVERSAL); the dual FIK problem is an explicit L -gauge transform of the original, $Y_{N-1+l}^\# = JY_{N-1-l+1}W$ with $W = \text{antidiag}(1/L, L)$, built from the node polynomial alone (exact in rationals; real w9 at 9.1×10^{-94} , dps 100); the gauge is h -free, so the wall’s orientation sits exclusively in the h -chain it does not see (SIGNED-STOKES-WALL-EQUIVALENT); the micro falsifier frozen (predict $0/2/2/3/1$ and $25/21/27$ blind). The claim splitting of note DLVII carried: the wall itself stands alone as PRIME.FREEMOMENT.POSITIVEPREFIX.01 [O]. Not evidence for or against RH. Machine-checked: [verification/v956_signedmoment_halffilling_duality.py]. [E] (the half-filling law, the complement/ h -duality, the inertia theorem, the four-path dictionary, the chain reversal and the L -gauge connection — exact in rationals and mp) + [C] (the census, offset, contractor and world ladders, per record) + [O] ($\beta_n > 0$ through the free window — the wall itself, open, typed)

The Reed–Muller identification (PRIME.PACKET.RM14.01). One probe (21/21 incl. the 3 must-fire controls; verdict RM14-EXACT; Lean companion PacketRM14.lean, 30 theorems). The 15-label channel row hull is the punctured $\text{RM}(1, 4)^* = [15, 5, 7]$ (enumerator $1 + 15z^7 + 15z^8 + z^{15}$ exact); χ_{NSR} is one codeword (the $7+8$ split its two sides, C_2 the affine bit); the self-reproduction cycle $\text{RM}(1, 3) \rightarrow E_8 \rightarrow V \rightarrow \text{RM}(1, 4)^* \rightarrow \text{RM}(1, 3)$ closes with exactly 1344 equivalences; the CSS code $[[15, 1, 3]]$ with dual $[15, 10, 4]$, logical distances $(7, 3)$ and triorthogonality $8/4/2$; ζ_8 typed [H]. Controls fire. No marker move, no RH claim. Machine-checked: [verification/v819_prime_packet_rm14.py]. [E] (code censuses; the cycle) + [C] (fingerprints)

The canonical check rule and the plane frames (PRIME.KRAUS.RM24.01). Two probes ($16/16 + 14/14$; verdicts KRAUS-RM24-RULE-CANONICAL + PLANEFRAMES-EXACT). The literal leg-support claim is dead twice (weights $1/2/3 < \text{distance } 4$; $Sp(4, 2)$ orbits $15+90$ vs $45+60$); the canonical ω -built rule identifies the rule-A protocol set with the 105 weight-4 checks of $[15, 10, 4]$ exactly, $Sp/\sigma/\text{deck}/\text{KMS}$ -covariant; all six Gram identities hold entrywise; $A_3 = 12 / B_3 = 16$ are the per-point plane completion counts — $\sigma_3(3) = 28$ and $a_3 = -4$ as plane-count statements; the graded frame intertwiner $V^*V = \sigma_3(n)I$, $V^*IV = a_nI$ exact for $n = 3, 5, 7$. Controls fire. No marker move, no RH claim. Machine-checked: [verification/v820_prime_kraus_rm24.py]. [E] (censuses; Gram identities; the intertwiner) + honest negative (the literal bijection)

The vacuum completion of the checks (PRIME.VACUUM35.01). One probe (22/22 incl. the 3 must-fire controls; verdict VACUUM35-EXACT). $140 = 105+35$; the Grams $22I+6J / 6I+J / 28I+7J$ entrywise with spectra $\{112, 22^{14}\} / \{21, 6^{14}\} / \{133, 28^{14}\}$; the E_7 completion $112 + 21 = 133$ as a matrix identity (the $E_7 \times A_1$ corpus reading a [C] fingerprint, anchor v170); Weitzenböck $H_{105}^T H_{105} = 2B^2 + 14I$ as the canonical label-side left factor with the honest v758 scope; the $\pm B$ anisotropy cancels inside one Gram; tight frame constant 28 on mean-zero; $\text{RM}(2, 4)$ dual-containing. Controls fire. No marker move, no RH claim. Machine-checked: [verification/v821_prime_vacuum35.py]. [E] (matrix identities) + [C] (the E_7 fingerprint)

The vacuum route closes (PRIME.CONTINUUM.UNSHORTEN.01). Two probes ($17/19 + 12/14$ with the four FAILs being the preregistered PSD deciders themselves; controls $3/3 + 3/3$; verdicts UNSHORTEN-DEAD + DILATION-DEAD). The vacuum-completion reading of the continuum dies

in both transcriptions: the one-slot bordering by the v758 mechanism verbatim and on scale (with the shape theorem: one slot induces only a rank-one pure- J coupling), and the 35-row Stinespring dilation — shape fixed exactly, $\times 13.1$ gain — still fails both sectors under both normalizations. The frozen fence: $\text{PSD} \iff \text{coupling} \leq c^* = (2/21)\lambda_{\text{pencil}}(T_{\text{dep}}, T_{\text{cont}}^2)$, measured deficits $\times 3 \times 10^7$ (GL1) / $\times 2 \times 10^2$ (f8); the continuum's completion role is exhausted inside T_{dep} . The RM integer layer stays certified. Controls fire. No marker move, no RH claim. Machine-checked: [verification/v822_prime_vacuum_dilation.py]. [E] (the RM layer) + honest kill (both transcriptions; the c^* fence)

v798/v819

Round-22 addendum: a second, independent $d = 4$ mechanism — the null selector $|v_d|^2 = \det M_d = d(4 - d)$ on the RR/Serre functor vector, with the bridge $g^2 - N^2 = 4d = |H|^2$ tying null to glue index on the same invariant $4d$ ([verification/v807_lorentz_nullselector.py]).

The reveal: in spinor coordinates the locking slope is *strictly monotone* in the window width α (66/66 pairs, Kendall 1.000, cross-ratio contraction CV 0.004) — the long-standing h -oscillation was α -jitter, i.e. a coordinate artifact; the approach $2 - r \sim \alpha^{-0.23}$ stays glacial and the three h -order gates FAIL honestly (the 1D monotonicity candidate is named, not claimed).

The check32 theorem (HECKE.CARRIER_CHECK32.01). One probe (20/20, ~ 40 s; verdict CHECK32-THEOREM). $f_8 = \eta(2\tau)^4 \eta(4\tau)^4 \equiv E_{\text{odd}} = \sum_{n \text{ odd}} \sigma_3(n) q^n \pmod{32}$, verified to $q^{100000} = 25000 \times$ the Sturm bound 4 (Sturm 1987 the one cited classical ingredient); corollary $a_p \equiv 1 + p^3 \pmod{32}$ on all 9591 odd primes $p < 10^5$ with the decoder $p \equiv (a_p - 1)^3 \pmod{32}$ (cube bijection on the 16 odd residues); maximality: mod 64 fails at q^3 (252/1000 census); $32 = 2^{9_{\text{car}}}$ typed observation; Hecke grammar clean (ramified U_2 law; harness amendment disclosed); controls fire (mutant 91.7%; random detection $\sim 31/32$). Lean kernel companion Check32.lean (13 theorems). No marker move, no RH claim. Machine-checked: [verification/v785_hecke_check32.py]. [E] (theorem modulo the one cited Sturm ingredient; Lean companion)

The positive C_2 lift (HECKE.POSITIVE_C2_LIFT.01). One probe (42/42, ~ 200 s; verdict C2LIFT-THEOREM). $A = (E_{\text{odd}} + f_8)/2$ and $B = (E_{\text{odd}} - f_8)/2$ are positive theta series ($\frac{1}{16}\theta_2(2\tau)^4\theta_3(4\tau)^4$ and $\frac{1}{16}\theta_2(2\tau)^4\theta_2(4\tau)^4$; verified to q^{50000}); $B = 16R$ with the closed convolution and the $\mathbb{N}^8$ microstate count (degeneracies 1, 4, 10, 24, 43); the eta-free generator $a_n = \sigma_3(n) - 32R(n)$ reproduces every odd f_8 coefficient — check32 becomes a kernel corollary; symbolic layer sympy-exact, classical citations typed and machine-verified; the packet automaton composition laws censused on 41053 coprime pairs + 70 prime powers; the five-condition validator passes all odd primes $< 10^5$ with joint detection 1.000000 and the tamper blind spot exactly the $16\mathbb{Z}$ lattice (15/16); controls fire (wrong factors 16/64 fail at q^3); two harness amendments disclosed; sheet-parity readings [C neu] fenced. Lean kernel companion PositiveC2Lift.lean (build green, 3406 jobs). No marker move, no RH claim. Machine-checked: [verification/v788_positive_c2_lift.py]. [E] (theorem-grade decomposition + automaton) + (MEASURED) (detection power)

The multirate ladder and its proof (HECKE.MULTIRATE2ADIC.01 + HECKE.CONSTDEPTH.01). One module from two probes (23/23 + 24/24, ~ 200 s; verdicts MULTIRATE-THEOREM/SPINLIFT-VERIFIED and CONSTDEPTH-THEOREM). The ladder $v_2(1+p^3-a_p) \geq 5 + 2[\chi_{-4}(p)=1] + [\chi_8(p)=1]$ holds for all 78497 odd primes $p < 10^6$ with sharpness attained per class (witnesses 3/7/5/17; depths 5/6/7/8; the exact-depth mechanism of classes 7 and 1 followed in round 21, [verification/v795_halving_tails_k5.py] — per-class infinitude stays open); character sifts I0–I3 Sturm-certified at level ≤ 512 ; the predeclared mod-512 must-fail fires at $n = 9$; the Shimura lift $\text{Sh}(g) = -8E_{\text{odd}} + 256H$ is exact to 160 with Kronecker factor χ_8 (the ladder's third rung); the $32 \rightarrow 256 \rightarrow 128$ semantics stays [C neu] observation. The proof: the weights $(1, -3, 2)$ telescope to the both-odd convolution; class 3 mod 8 pinned by the unique $x^2 + 2y^2$ ($h = 1$) $\Rightarrow v_2 = 5$ exactly; class 5 mod 8 by the ternary bridge $R_3(p)/8 \equiv \#\{x^2 + 4w^2 = p\} = 1 \pmod{2}$ ($h = 1$) $\Rightarrow v_2 = 7$ exactly; two named classical ingredients [N1]/[N2], instances machine-verified; 10^6 census with zero exceptions; composites violate as required. No marker move, no RH claim. Machine-checked: [verification/v789_multirate_constdepth.py]. [E] (ladder modulo two cited ingredients; constant

depths proven)

The SNF fingerprint and the μ_4 packet (HECKE.SNF_THETA.01 + HECKE.MU4_PACKET.01).

One module from two probes (18/18 + 17/17; verdicts SNF-FINGERPRINT/MU4-PARTIAL). The correction theta has the representation identity $256R(n) = \#\{\text{odd}(u, v) : Q = 4n\}$ and its SNF $(1^4, 2^4)$ matches the ramified inclusion $(1+i)L \subset L$ exactly — but the isometry census is empty at every admissible level (kissing 240 vs 8, proof-grade; $0/20160 GL(4, \mathbb{F}_2)$, alternating vs odd form; the naive 4+4 split inadmissible by the replicated v638 theorem): a fingerprint, not an isometry. The adjudication: the new exact identity $c_{\text{sig}} = \frac{1}{15}E_4(q^2) - \frac{6}{5}E_4(q^4) + \frac{32}{15}E_4(q^8) - 8f_8$ — the cusp part of the quartic μ_4 character is exactly $-8f_8$ with $-8 = 52 - 60 = -\text{rank}(E_8)$; the quadratic (C_2) channel is pure Eisenstein; the all-shell quartic vanishing is false (closed series $\prod(1+q^{2n})^{-4}$, fails from grade 2). Controls fire. No marker move, no RH claim. Machine-checked: [verification/v790_snf_mu4_theta.py]. [E] (exact identities; census honestly empty) + [C neu] (readings fenced)

The halving tails and the $k = 5$ mechanism (HECKE.HALVINGTAILS.01 + HECKE.K5ANOMALY.01).

One module from two probes (20/20 + 17/17; verdicts TAILS-IDENTIFIED/K5-MECHANISM-FOUND). Exact identities $v_2(D_p) = 6 + v_2(X_7(p))$ for $p \equiv 7$ and $= 8 + v_2(X_1(p))$ for $p \equiv 1 \pmod{8}$, with $X_7 = H/2$, $X_1 = H/8$ termwise-integral divisor sums (composites included; 10^6 census zero exceptions); class-7 base $\iff R_3(p) \equiv 16 \pmod{32}$ ($h = 1$ ternary via the χ_{-4} bridge); the class-1 two-shape criterion exact, its single-character bridge typed open. The anomaly: $k = v_2(X_1)$ is deterministic on the residue-tower cells $(m, t) = (v_2(p-1), 2\text{-power depth of } 2)$ with zero exceptions; $k = 5$ lives only in cell $(5, 3)$ of density $1/64$, so $P(k=5) = 1/128$ — exactly the observed half mass. The class-7 mirror law $v_2(D_p) = 3 + v_2(p+1)$ through $k = 4$ explains the class-3 constancy; the governing-field derivation stays typed open (Cohn–Lagarias frame cited). Controls fire. No marker move, no RH claim. Machine-checked: [verification/v795_halving_tails_k5.py]. [E] (identities and tower determinism modulo the named $h = 1/\text{Gauss ingredients}$) + [O] (governing field)

The R -microstate identification (HECKE.R_MICROSTATE.01).

One probe (14/14; verdict R-NO-ARROW-REALIZATION; frozen dictionary, the disclosed pilot produced only kills). The honest negative: $R(p) = 1, 4, 10, 24, 43, 68$ has no arrow-level realization at the tested places — type-B orbit counts $(1, 4, 13)$ killed at $p = 7$; the type-B set is not invariant under any deployed extension; the refined census separates all 13 orbits; pointwise switch arrows do not exist; the Kneser J -stability census has ≤ 2 classes. The count identity $16B_n = 256R(n)$ (= the odd-vector count of $\text{diag}(1^4, 2^4)$ at $4n$) is exact everywhere but count-level only: the SNF fingerprint is shared while the minimum-vector counts (8 vs 240) exclude any isometry. The packet and arrow layers share totals, not the R -grading. Controls fire. No marker move, no RH claim. Machine-checked: [verification/v797_r_microstate_identification.py]. [E] (count identities) + honest negative on record

The local-Clifford kill and the mod-8 rule completion (HECKE.LOCAL.CLIFFORD.01).

One probe (16/18 with the two FAILs being the preregistered decider gates themselves; controls 4/4; verdict LOCAL-CLIFFORD-BREAKS; one declared bar re-freeze carried). The analytic activation-ordering hypothesis dies: all four $p \pmod{8}$ class sectors fail PSD — signed class-indicator combinations carry no completed L -function (the trivial mod-8 component is imprimitive) — and the margin ordering does *not* track the proven activation depths (Spearman +0.40). Class 1 is the unique positivity-completable class (Euler repair exact, $+1.4 \times 10^{-5}$). The arithmetic multirate theorem (constant depths of classes 3 and 5 mod 8) is untouched; the Clifford-activation reading stays decorative analytically. Positive side-result: χ_8/χ_{-8} are two *new* PSD instances of the $\Gamma_{\mathbb{R}}$ conductor rule (exact parities: χ_8 even, χ_{-8} odd) — the rule map now covers the full mod-8 dual group. Controls fire. No marker move, no RH claim. Machine-checked: [verification/v806_hecke_local_clifford.py]. Honest negative on record + (MEASURED) (the two new rule instances)

The Lorentz congruence [[E] + honest negative]: $P = [[3, 0, 0], [3, 0, 2], [-1, 1, -1]]$ with $\det P = -6$ satisfies $P^T J_{\det} P = J_{\text{fix}}$ *exactly* — the prime-front determinant form ($\det 2$) and the v604 cover

polarization lattice (det 72) are the *same* rational quadratic form, the cover an index-6 sublattice ($36 = 6^2$, $6 = p_2(a)$); the review's follow-up test (integer R to $B = M^\dagger J$) is *ill-posed* as stated (B is complex symmetric, det $B = 8$ verified); on the reformulated $\mathbb{Q}(\omega)$ level the third symmetric-Gauss ratio is an exact square; P -canonicity and the Hodge-chamber question are the named opens. The review's RH architecture is preregistered as the contract **PRIME.WEIL.OPERATOR.01** with verified citations (Suzuki [arXiv:2606.09096](#); numerical realization [arXiv:2607.24830](#)). No marker moves; no RH statement.

with 240 minimal vectors and 2160 on the second shell (the v625 theta identity on the code model).

; **PRIME.WEIL.OPERATOR.01**: kill tests K1–K3 $\rightarrow$ W1 theorem-closed v643

the Suzuki archimedean constants to 25+ digits, and the completed-zeta functional equation (3×10^{-31}).

and **PRIME.WEIL.OPERATOR.01** W2–W4)

incidence isomorphism (the typed reason the v822 dilation died).

One module from two probes (22 checks with the three honest h -order FAILs encoded +14/14; verdicts LORENTZ-COORDS-REVEAL/NULLSELECTOR-ALGEBRAIC).

local Hecke theorem holds at all 15 points ($12 + 16 = 28 = \sigma_3(3)$, $12 - 16 = -4 = a_3$, with $x^\perp/\langle x \rangle$ semantics);

; the packet numerator equals the code Walsh transform at every level ≤ 16 , and $\hat{m}_2(n) = -1/15$ at *every* odd $n \leq 16500$ — v817's per-prime measurement is the prime restriction of a character theorem; typed spectral-only (the gradings do not refine each other); upgraded in round 36 to *all* odd shells (**E8.SHELL.GLOBAL.01**, see the v875 card).