# V-DST Fixed-Time Responses, Classical Reports, and Quantum Return

*A quantitative Shredder audit of V and V-B, with a corrected dynamical-host comparison*

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### Abstract

We give an access-sensitive reporting construction for the fixed-time scalar responses and finite compressions of V and V-B. The initial-surface Ward defect, compact curvature interpolation on a declared transverse-traceless plane, external linear retarded coefficient, mixed quadratic coefficient, and Newton–wave cubic form remain distinct objects. The main additions are quantitative interfaces between these objects and complete finite readout. We construct curvature-based classical transcripts with an explicit Gram-conditioning error bound. A joint sesquilinear-form cutoff estimate is converted, after a fixed finite compression, into an explicit linear diamond-norm estimate for the entire recorded instrument. For V-B's compressed cubic qubit we evaluate the exact optimal recovery errors at both access cuts: at measurement strength r, record-only access has error (3 − r)/4, whereas retaining the conditional qubit gives (1 − √(1 − r^2))/2. The universal classical-only floor 1 − 1/d, including its implementation-error weakening, is proved separately and is never applied after silently dropping a quantum residual. These calculations use established measurement and recovery principles; no priority claim is made for those principles. A conditional scalar echo calculation supplies robust deficit-sensitive report laws on the prescribed cone, not on I-D's Host B. We identify why neither local flatness, a resonance census, nor a null-energy-condition violation supplies the missing host-transfer theorem. The potential value is methodological: form-level distinctions, regulator errors, geometric information, and quantum return become separately testable claims. No continuum acquisition apparatus, Host-B echo evaluation, intrinsic Newton inverse, Einstein dynamics, spacetime emergence, or inherited characteristic quantum coefficient is constructed.



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## Purpose, philosophy, and the corrected scope

The programme has three different stages:

$$\text{classical response} \;\rightarrow\; \text{current or represented form} \;\rightarrow\; \text{specified complete instrument.}$$

Neither arrow follows from terminology alone. V treats classical admissibility and several separate perturbative or form-valued representations. V-B supplies a local Grade-S presentation and finite instruments obtained by compression [CheungV,CheungVB].

The present paper completes the finite transcript and recovery audit of those constructions. It does not convert the

missing dynamical-host transfer into an assumption disguised as a conclusion.

### Enter and the Shredder distinction

In the Enter interface, destructive readout consumes measured quantum names and returns classical labels together with every declared surviving quantum output. Consumption is an access statement. It is not a claim that all physical implementing degrees of freedom cease to exist. Cheung's philosophical account distinguishes destructive readout, quantum recovery, physical implementation, and geometric identification [CheungPhilosophy,CheungI].

Spacetime Enter adds a prescribed geometry, laboratory locations, accessible algebras, and a complete control and resource specification [CheungIB]. I-C's Shredder discipline asks whether the *complete accessible output* is classical, rather than whether one selected output happens to be a classical record [CheungIC].

We therefore maintain three ledgers:

**Report.** The finite classical transcript, including failures and stop labels.

**Residual.** Every quantum output available to a continuation or decoder.

**Implementation.** The declared preparation, couplings, storage, environments, Hamiltonians, work, and reservoir accounting. Equality of report laws does not imply equality of residual instruments. Equality of channels does not determine heat. These distinctions also belong to the standard instrument and entanglement-breaking frameworks [DaviesLewis,HSR,ReebWolf].

We use explicitly specified Born instruments. We do not rederive the Enter characterization from an abbreviated axiom list.

### What is proved and what is only compared

The new mathematical arguments below prove:

• a curvature-to-transcript construction and its conditioning bound on each declared finite TT plane;

• complete-channel estimates from a fixed finite compression of convergent forms;

• exact access-dependent recovery values for the compressed cubic qubit;

• a robust finite-report consequence of a declared conical scalar echo kernel;

• precise non-transfer statements for the proposed placement on I-D's dynamical hosts.

The classical mechanisms already in V and V-B are attributed, not claimed as new. Their basic current, residual-wave, and curvature identities are reproduced to make the reporting construction intelligible.

The Newton–wave kernel estimate and its nonzero regular-region witness are explicit analytical input data in Specification ; their full kernel construction is not re-proved here. The interface theorem applies to any forms satisfying that specification. A separate elementary packet example supplies a completely evaluated cubic benchmark.

The proposed Host-B placement is *not* completed: no same-host response, gauge, Green-operator, or echo identification is supplied by the frozen data. Section identifies the exact missing objects. This is an unresolved transfer, not a nonexistence theorem.

## The flat response and its complete Ward defect

### Signs, domains, and the fixed-time problem

Use the conventions of V and V-B:

$$\eta = \mathrm{diag}\,(-1,1,1,1), \qquad \mathrm{Box} = -\partial_t^2 + \Delta, \qquad P = \mathrm{Box} - m^2, \qquad \Omega_m = (-\Delta + m^2)^{1/2}.$$

Here $m > 0$; the residual-wave argument also works at $m = 0$. Indices are moved with $\eta$. For a symmetric covariant tensor $h$, let

$$\bar{h} = h - \tfrac{1}{2}\eta \mathrm{tr}_\eta\, h, \qquad (Dh)^\nu = \partial_\mu \bar{h}^{\mu\nu}, \qquad L_h\varphi = -h^{\mu\nu}\partial_\mu\partial_\nu\varphi - (Dh)^\nu\partial_\nu\varphi.$$

For a covector $\xi$, set

$$(K\xi)_{\mu\nu} = \partial_\mu\xi_\nu + \partial_\nu\xi_\mu, \qquad X_\xi\varphi = \xi^\nu\partial_\nu\varphi.$$

Then

$$DK\xi = \mathrm{Box}\,\xi, \qquad L_{K\xi}\varphi = -[P, X_\xi]\varphi.$$

Fix a real free scalar $P\varphi = 0$, initially with compact smooth Cauchy data, and a real $f \in C_c\^{\infty}((0, T) \times \mathbb{R}\^3)$. The zero-data response is

$$PS_0(h)\varphi = -L_h\varphi, \qquad S_0(h)\varphi|_0 = \partial_t S_0(h)\varphi|_0 = 0, \qquad B_f(h, \varphi) = \int f S_0(h)\varphi \,\mathrm{mathop\,d}^4x.$$

The scalar is held fixed in this metric functional.

For the stated sign of $P$, the retarded time kernel is

$$G_{m,R}(t) = -\Theta(t)\frac{\sin(t\Omega_m)}{\Omega_m},$$

and $G_{m, A\} = G_{m, R\}\^{*\}$. Set

$$u = -G_{m,A}f, \qquad V = \Theta(t)u.$$

Duhamel's formula and transposition give

$$B_f(h, \varphi) = \int_0^T uL_h\varphi \,\mathrm{mathop\,d}^4x.$$

All integrations concern the compact truncated causal set

$$K_f = J_\eta^-(\mathrm{supp}\, f) \cap \{0 \le t \le T\}.$$

The noncompact auxiliary waves are not extended by zero across a laboratory boundary.

**Current and surface term**

**Proposition.** For every smooth $h$,

$$B_f(h, \varphi) = \langle J_{\mathrm{raw}}, h\rangle,$$
$$J^{\mu\nu}_{\mathrm{raw}} = \partial^{(\mu}V\partial^{\nu)}\varphi - \frac{1}{2}\eta^{\mu\nu}\partial_\alpha(V\partial^\alpha\varphi).$$

This compact order-zero distribution has the decomposition

$$J_{\mathrm{raw}} = \Theta(t)J_{\mathrm{bulk}} + \delta(t)j_\Sigma,$$

where $J_{bulk\}$ is with $V = u$, and

$$j^{00}_\Sigma = \tfrac{1}{2}u_0\dot{\varphi}_0, \qquad j^{0i}_\Sigma = -\tfrac{1}{2}u_0\partial_i\varphi_0, \qquad j^{ij}_\Sigma = \tfrac{1}{2}\delta^{ij}u_0\dot{\varphi}_0.$$

*Proof.* In $\langle V, L_h\varphi\rangle$, integrate the derivatives of $h$ by parts. The terms containing $Vh\^{\mu\nu\}\partial_{\mu\}\partial_{\nu\}\varphi$ cancel. The remaining expression is . A cutoff equal to one near $K_f$ permits arbitrary smooth $h$.

Since

$$\partial^\mu(\Theta u) = \Theta\partial^\mu u - \delta^\mu_0\delta(t)u_0,$$

the singular part is exactly . The other terms are bounded, piecewise smooth densities on a compact set.

This is V's current reconstruction, including its initial-surface measure [CheungVRaw]. Dropping that measure changes the observable.

Define $K\^{*\}J = -2\partial_{\mu\}J\^{\mu\nu\}$, paired against covectors.

**Proposition.** The complete Ward defect is

$$\boldsymbol{H} = K^* J_{\mathrm{raw}} = \gamma + \delta(t)a + \delta'(t)b,$$

with

$$\gamma^\nu = f\partial^\nu\varphi, \qquad a^\nu = u_0\partial^\nu\varphi_0 - u_0\partial_t\partial^\nu\varphi|_0, \qquad b^\nu = u_0\partial^\nu\varphi_0.$$

Moreover,

$$B_f(K\xi, \varphi) = \langle \boldsymbol{H}, \xi \rangle.$$

Thus compact gauge tests strictly after $t = 0$ test $\gamma$, while arbitrary compact gauge tests test the whole of $H$.

Let $E_1 = G_{1, A\} - G_{1, R\}$ be the componentwise massless causal propagator. Annihilation of every smooth vector wave $Box\ \xi = 0$ with compact smooth Cauchy data is equivalent to $E_1H = 0$.

*Proof.* For a scalar distribution $v$, direct differentiation gives

$$2\partial_\mu\Big(\partial^{(\mu}v\,\partial^{\nu)}\varphi - \tfrac{1}{2}\eta^{\mu\nu}\partial_\alpha(v\partial^\alpha\varphi)\Big) = (Pv)\partial^\nu\varphi.$$

Also

$$PV = -f - \delta(t)\dot{u}_0 - \delta'(t)u_0.$$

Use $c(t)\delta^{'}(t) = c(0)\delta^{'}(t) - \dot{c}(0)\delta(t)$. This proves –. Compact integration by parts proves the gauge pairing.

Testing arbitrary values and first time derivatives at the initial surface separates $a$ and $b$. The future-supported bulk tests separate $\gamma$.

If all residual waves are annihilated, test with $\xi = E_1v$, for arbitrary compact smooth vector tests $v$. Skew-adjointness of $E_1$ gives $E_1H = 0$. Conversely, this equality makes the advanced and retarded potentials of $H$ equal. Their common support lies in a compact Minkowski diamond. Writing the common distribution as $A$, one has $Box\ A = H$, and hence

$$\langle \boldsymbol{H}, \xi \rangle = \langle A, \mathrm{Box}\,\xi \rangle = 0.$$

These are the defect distinctions of V [CheungVDefect]. The stronger full-space representability classifications in V and V-B use their separately stated compact smoothing argument: raw representability is controlled by $H = 0$, and harmonic-prescription representability by $E_1H = 0$ [CheungVClassification,CheungVB]. Those classifications are not reinterpreted here as quantum-recovery theorems.

**A residual-wave obstruction that reporting cannot repair**

**Proposition.** There are compact smooth scalar and vector-wave Cauchy data and a nonnegative future smearing for which

$$B_f(K\xi, \varphi) > 0.$$

For the fixed resulting $\varphi$, $\xi$, the smearings with this pairing nonzero form an open dense subset of an appropriate fixed-support Fréchet test space. No compact conserved current can represent the response on a metric solution space containing this residual pure gauge.

*Proof.* Choose $F \in C_c^{\infty}(\mathbb{R}^3; \mathbb{R})$ with $\partial_1F \equiv 0$, and impose

$$\varphi_0 = 0, \quad \dot{\varphi}_0 = F, \qquad \xi^1_0 = 0, \quad \dot{\xi}^1_0 = \partial_1F, \quad \mathrm{Box}\,\xi^1 = 0,$$

with the other vector components zero. Finite propagation gives compact Cauchy support, and $(K\xi)_{01}|_0 = \partial_1F$, so the gauge perturbation is nonzero.

Put $w = X_{\xi}\varphi = \xi^1\partial_1\varphi$. The differential identity above and Cauchy uniqueness give

$$S_0(K\xi)\varphi = w - \cos(t\Omega_m)w_0 - \frac{\sin(t\Omega_m)}{\Omega_m}\dot{w}_0 = w.$$

Taylor expansion yields, locally uniformly in space,

$$w(t, x) = t^2(\partial_1F(x))^2 + O(t^4).$$

Choose a nonzero nonnegative $f$ supported where $w > 0$.

For a compact set $K$ whose interior meets that positive region, let

$$\mathscr{D}_K = \{f \in C^\infty(\mathbb{R}^4; \mathbb{R}) : \operatorname{supp} f \subseteq K\}.$$

The functional $f \mapsto \int fw$ is nonzero and continuous. Its kernel is a closed proper linear subspace, so its complement is open dense.

Finally, every smooth compact conserved tensor $J$ satisfies $\langle J, K\xi\rangle = 0$. It cannot reproduce a nonzero value on this gauge solution.

The witness is the one in V [CheungVResidual]. It is not spatial TT: its $01$-component is nonzero. The conclusion therefore cannot be transferred to a smaller TT plane by ignoring the domain. Nor can a later finite readout turn this noninvariant classical functional into an invariant one on the unchanged quotient.

## Compact TT-plane currents and explicit classical transcripts

### A declared separating plane

Let $v_1 = e$, $v_2 = r$ be independent real spatial-TT waves:

$$\Box v_a = 0, \qquad (v_a)_{0\mu} = 0, \qquad \partial_i (v_a)_{ij} = 0, \qquad \delta^{ij}(v_a)_{ij} = 0.$$

Their Cauchy data are Schwartz with a common Fourier gap around zero. Define

$$\mathscr{V} = \operatorname{span}_{\mathbb{R}} \{v_1, v_2\}.$$

A nonzero Fourier-gap Schwartz datum is not compactly supported: compact smooth spatial support would make its Fourier transform entire, so an open Fourier gap would force it to vanish. These support classes must remain distinct [CheungV].

Choose an open regular region $O$ in the response slab such that the two electric curvature fields restricted to $O$ are linearly independent. This is a substantive separating-region condition. It is not asserted for every arbitrarily chosen small chart.

For a symmetric tensor $h$, set

$$\mathcal{R}_{\mathrm{el}}(h)_{ij} = \frac{1}{2}\big(\partial_0\partial_i h_{0j} + \partial_0\partial_j h_{0i} - \partial_i\partial_j h_{00} - \partial_0^2 h_{ij}\big).$$

For TT waves, $\mathcal{R}_{el}(v_a) = -1/2\Delta v_a$.

Given $C^{ij} \in C_c^\infty(O)$, symmetric, define

$$J_C^{00} = -\tfrac{1}{2}\partial_i\partial_j C^{ij}, \qquad J_C^{0j} = J_C^{j0} = \tfrac{1}{2}\partial_0\partial_i C^{ij}, \qquad J_C^{ij} = -\tfrac{1}{2}\partial_0^2 C^{ij}.$$

**Lemma.** The tensor $J_C$ is smooth, compactly supported and conserved, and

$$\langle J_C, h\rangle = \int C^{ij}\mathcal{R}_{\mathrm{el}}(h)_{ij}\,\mathrm{mathop\,d}^4x.$$

In particular, it annihilates every smooth pure gauge.

*Proof.* Differentiating makes each divergence zero by commutation of partial derivatives. Two integrations by parts give . Both symmetric $0j$-components are included in the pairing. The electric linearized curvature of $K\xi$ vanishes by direct substitution.

This is the explicit curvature-current construction of V [CheungVCurvature].

**Theorem.** There is a nonnegative $\rho \in C_c^\infty(O)$ such that

$$G_{ab} = \int \rho\, \mathcal{R}_{\mathrm{el}}(v_a)_{ij}\mathcal{R}_{\mathrm{el}}(v_b)_{ij}\,\mathrm{mathop\,d}^4x$$

is positive definite. Put

$$C_a^{ij} = \rho \sum_b (G^{-1})_{ab}\mathcal{R}_{\mathrm{el}}(v_b)_{ij}, \qquad J_a = J_{C_a}.$$

Then

$$\langle J_a, v_c\rangle = \delta_{ac}.$$

For the response , define

$$b_a = B_f(v_a, \varphi) = -\int_0^T u(v_a)^{ij}\partial_i\partial_j\varphi\,\mathrm{mathop\,d}^4x.$$

The compact conserved tensor

$$J_f = b_1 J_1 + b_2 J_2$$

represents the actual response on $\mathscr{V}$:

$$B_f(\lambda_1 v_1 + \lambda_2 v_2, \varphi) = \langle J_f, \lambda_1 v_1 + \lambda_2 v_2 \rangle = b \cdot \lambda.$$

*Proof.* Linear independence of the two curvature fields means that their component evaluations separate the two-dimensional coefficient space. Select a finite separating family of such evaluations. The sum of their squares is a positive definite quadratic form.

Choose nonnegative normalized bumps near those evaluation points. Their weighted Gram matrices approach that positive definite form, with all additional component squares nonnegative. For a sufficiently small fixed choice of bumps, their sum $\rho$ gives $G > 0$. Lemma now gives the duality.

For TT $v_a$, $Dv_a = 0$, so gives the displayed expression for $b_a$. Linearity gives and its pairing.

The dual construction is due to V [CheungVDual]. Its Gram matrix is positive definite; the representing current need not be positive in any energy-condition sense. Two interpolation conditions are not dense-TT representability.

**Conditioning and finite reporting**

The following estimate makes the classical reporting interface quantitative.

**Proposition.** Let $G \geq gI_2$, $g > 0$. For a plane element $h = \lambda_a v_a$, the unnormalized curvature tests

$$z_a = \int \rho \, \mathcal{R}_{\mathrm{el}}(v_a)_{ij} \mathcal{R}_{\mathrm{el}}(h)_{ij} \, \mathrm{mathop\,d}^4 x$$

give $z = G\lambda$. Suppose supplied approximations satisfy

$$\|\widehat{G} - G\| \leq \varepsilon_G < g/2, \quad \|\widehat{z} - z\| \leq \varepsilon_z, \quad \|\widehat{b} - b\| \leq \varepsilon_b.$$

Then $G$ is invertible and, for $\hat{\lambda} = G^{-1}\hat{z}$,

$$\|\hat{\lambda} - \lambda\| \leq \frac{2}{g}(\varepsilon_z + \varepsilon_G \|\lambda\|),$$

$$|\hat{b} \cdot \hat{\lambda} - b \cdot \lambda| \leq \varepsilon_b \|\lambda\| + (\|b\| + \varepsilon_b)\frac{2}{g}(\varepsilon_z + \varepsilon_G \|\lambda\|).$$

*Proof.* The smallest eigenvalue of $G$ is at least $g/2$. Consequently $\|G^{-1}\| \leq 2/g$, and

$$\hat{\lambda} - \lambda = \widehat{G}^{-1}((\hat{z} - z) - (\widehat{G} - G)\lambda).$$

This proves . Expand the response difference using $b$, and apply Cauchy–Schwarz.

For a real supplied value $x$, fix a dimensionally calibrated scale $\sigma > 0$, and define

$$p_\sigma(x) = \frac{1 + \tanh(x/\sigma)}{2}, \qquad |\varepsilon_\sigma(x)\rangle = \sqrt{1 - p_\sigma(x)}|0\rangle + \sqrt{p_\sigma(x)}|1\rangle.$$

Preparing this qubit and destructively reading it produces a finite bit. It does not return that qubit as a quantum name.

For example, use three values

$$x_1 = \lambda_1, \qquad x_2 = \lambda_2, \qquad x_3 = b \cdot \lambda$$

after fixed choices of units. A supplied preparation produces the product law

$$P_\lambda(w) = \prod_{j=1}^{3} p_{\sigma_j}(x_j)^{w_j}(1 - p_{\sigma_j}(x_j))^{1 - w_j}, \qquad w \in \{0,1\}^3.$$

A declared common failure probability $v$ is included by

$$P_\lambda(\perp) = v, \qquad P_\lambda(w) = (1 - v)P_\lambda(w).$$

The same notation for the success probabilities is understood on the right-hand side.

The exact success law determines the two plane coordinates, because $p_{\sigma}$ is strictly increasing. One realized finite word does not determine those real coordinates.

**Proposition.** If each supplied value has error at most *ε_j*, and the implemented complete classical reporting law has additional total-variation error at most *δ_imp*, then

$$\mathrm{TV}\,(\widehat{P}_{\lambda}, P_{\lambda}) \le (1 - \nu) \sum_{j=1}^{3} \frac{\varepsilon_j}{2\sigma_j} + \delta_{\mathrm{imp}}.$$

For *x_3*, the right side of is an admissible *ε_3*.

*Proof.* The derivative of *p_{σ}* has magnitude at most *1/(2σ)*. Total variation between Bernoulli laws is the difference of their success probabilities. A telescoping of product laws bounds their total variation by the sum of the marginal distances. The identical failure weights multiply the success difference by *1 − ν*. Apply the triangle inequality.

**Remark.** Equation is a specified classical-value-to-register interface. Neither its definition nor the Gram identity constructs a physical map acquiring an unknown continuum field. The same limitation is explicit in I-C's supplied-preparation interface [CheungIC]. A discontinuous rounding code would require a separate threshold-margin condition.

A quantum-input version can be defined without ambiguity for a finite installed menu *λ^{(1)}, …, λ^{(d)}*. On *Q = ℂ^d*, set

$$F_w = \sum_{n=1}^{d} P_{\lambda^{(n)}}(w)\mathrm{proj}\, n, \qquad \mathscr{C}_{\mathrm{menu}}(\rho) = \sum_{w} \mathrm{tr}\,(F_w \rho)\mathrm{proj}\, w.$$

This is a CPTP channel because *∑_w F_w = I_Q*. Every off-diagonal code matrix unit is discarded. Section applies to this actual quantum-to-classical channel, not directly to a classical parameter *λ*.

## Represented forms and compression before measurement

### The analytical objects are not interchangeable

The source objects have different degrees and domains [CheungV,CheungVB]: toprule Object Declared construction Boundary

midrule Classical response *B_f(h, φ)*, with fixed scalar and initial data Gauge and solution-space question

TT restriction Compact currents dual to a fixed finite plane Not a dense-TT theorem

External coefficient A compactly switched first retarded scalar insertion Linear free field, not the cubic form

Metric oscillator One oscillator times one scalar factor Mixed quadratic, not a local metric field

Newton–wave composition Stress inserted into a prescribed inverse before the response, then fully Wick ordered Symmetric cubic form, not an unregulated self-adjoint generator

bottomrule

For reference, with the source's compact switch *g*,

$$\mathrm{Q}_H = -\partial_\mu(\overline{H}^{\mu\nu}\partial_\nu) - \tfrac{1}{2}m^2 \mathrm{tr}_\eta H, \qquad H = gh.$$

The specified external first retarded coefficient is

$$R_{1,1} = \varphi(\mathrm{Q}_{gh}(-G_{m,A}f)), \qquad \varphi^{(1)}_{g,h} = -G_{m,R}\mathrm{Q}_{gh}\varphi.$$

The sign in the compact test is positive: the retarded minus is already contained in *−G_{m, A}f*. The numerical contractions have scaling degree at most three in four relative dimensions under the stated coefficientwise normalization [CheungVRetarded]. A nonzero difference of minimal extensions would be supported at the relative origin and would have scaling degree at least four; hence no such difference is admitted. This subcritical argument does not define a second vertex product [BF].

The one-oscillator coefficient has the different form

$$Q_g \otimes \Phi(v_e) + \Pi_g \otimes \Phi(v_r).$$

It is a real quadratic polynomial on its finite-particle core. The analytic-vector number estimate is the quadratic one; it is not a proof of essential self-adjointness for the cubic Newton–wave form [CheungV,Nelson].

### Explicit analytical input for the instrument theorem

Let $\mathcal{D}$ be a complex vector space continuously embedded as a dense domain in a Hilbert space $\mathscr{H}$. The input consists of finitely many symmetric sesquilinear forms $t_k$ on $\mathcal{D}$, linear in the second argument, and symmetric regulated forms $t_{k, a}$. For some seminorm $p$, constants $C_k$, and $e(a) \to 0$, assume

$$|(t_{k,\mathbf{a}} - t_k)(\psi, \chi)| \le C_k e(\mathbf{a}) p(\psi) p(\chi).$$

Choose an isometry

$$V_X : Q = \mathbb{C}^d \to \mathscr{H}, \qquad V_X Q \subset \mathcal{D},$$

fixed independently of $a$, and define Hermitian matrices

$$(A_k)_{ij} = t_k(V_X|i\rangle, V_X|j\rangle), \qquad (A_{k,\mathbf{a}})_{ij} = t_{k,\mathbf{a}}(V_X|i\rangle, V_X|j\rangle).$$

No continuum exponential of $t_k$ is assumed.

V's fully Wick-ordered Newton–wave form supplies, in its own domain and normalization, the estimate

$$e(\mathbf{a}) = \Lambda^{-1} + \delta_{\mathrm{tr}} + \varepsilon,$$

where the three parameters denote ultraviolet cutoff, transfer exclusion, and initial-edge smoothing. The source estimate is joint and profile-independent in its declared class [CheungVLimit]. It is a form estimate, not a closability or spectral-calculus theorem.

In particular,

$$: AB : C = : ABC : + \langle AC\rangle B + \langle BC\rangle A$$

shows why normal ordering the stress alone is not the full cubic prescription. The extra linear contractions must not be silently retained or silently reinterpreted as the external coefficient.

**Proposition.** Let $v_i = V_X|i\rangle$, and set

$$\Gamma_V = \sum_{i=1}^{d} p(v_i)^2, \qquad C_* = \max_k C_k.$$

Then

$$\max_k \|A_{k,\mathbf{a}} - A_k\| \le C_* \Gamma_V e(\mathbf{a}).$$

*Proof.* For $x \in \mathbb{C}^d$,

$$p(V_X x) \le \sum_i |x_i| p(v_i) \le \sqrt{\Gamma_V}\|x\|.$$

Apply to $V_X x$, $V_X y$, with unit $x$, $y$, and take the operator-norm supremum.

This is a fixed-carrier theorem. It is not uniform as $d$, $V_X$, or its domain seminorms change. A particle-number cutoff in a continuum Fock space does not itself give a finite $d$.

### The cubic witness and a concrete independent example

The regular-region source witness provides a vacuum $\Omega$ and a normalized three-particle vector $\chi_3$ such that

$$c_f = \mathfrak{c}(\chi_3, \Omega) > 0,$$

for the specified symmetric odd cubic form $\mathfrak{c}$ [CheungVCubicWitness]. Odd scalar parity makes both diagonal entries vanish on $\mathrm{span}\{\Omega, \chi_3\}$. After the displayed phase convention, its compression is

$$A_0 = c_f X.$$

The two states

$$\psi_\pm = \frac{|0\rangle \pm \varepsilon|1\rangle}{\sqrt{1 + \varepsilon^2}}$$

therefore have cubic expectation difference

$$\frac{4\varepsilon c_f}{1+\varepsilon^2}.$$

A polynomial of field degree at most two cannot connect vacuum and three particles. Its expectations in the corresponding continuum preparations are equal. This is a field-degree statement, not a claim that arbitrary nonlinear measurements of lower-degree observables have identical laws.

**Example.** Choose a normalized Schwartz one-particle vector $u$, let $a = a(u)$, and define on the finite-particle domain

$$T = :(a + a^\dagger)^3: = a^{\dagger 3} + 3a^{\dagger 2}a + 3a^\dagger a^2 + a^3.$$

Set $\chi_3 = a^{\dagger 3}\Omega/\sqrt{6}$. Then

$$\langle \chi_3, T\Omega\rangle = \sqrt{6}, \qquad V_X^\dagger T V_X = \sqrt{6}\, X.$$

Creation and annihilation estimates give

$$\|T\chi\| \le C\|(N+1)^{3/2}\chi\|.$$

Thus this example defines the required symmetric form and finite compression explicitly. No self-adjoint unregulated cubic generator is needed. It is an independent packet polynomial, not an identification with V's Newton–wave kernel.

## Complete clock instruments and the explicit discard

Choose a fixed calibration

$$L > \max_k \|A_k\|,$$

and, for $y = \pm 1$, set

$$E_{k,y} = \frac{1}{2}(I + yA_k/L), \qquad M_{k,y} = \sqrt{E_{k,y}}.$$

Let $C = \mathbb{C}^D$ have orthonormal clock basis $\{|\tau_k\rangle\}$, and write $D_k = \langle \tau_k| \otimes I_Q$.

**Theorem.** The map

$$\mathscr{I}(Z) = \sum_{k,y} |k\rangle\langle k|_R \otimes \operatorname{proj} y_Y \otimes M_{k,y} D_k Z D_k^\dagger M_{k,y}$$

is CPTP, including every untouched reference. It consumes the clock and probe names, not the surviving $Q$-factor. For $\sigma_k = D_k \rho D_k^\dagger$ with $p_k = \operatorname{Tr}\sigma_k > 0$,

$$\mathbb{E}[Ly \mid k] = \frac{\operatorname{tr}(A_k\sigma_k)}{p_k}.$$

The normalized quantum state on a positive $(k, y)$-branch is the corresponding block divided by its trace. No normalized state is assigned to a zero-probability branch.

Its record-only marginal is the distinct channel

$$\mathscr{C}(Z) = \operatorname{Tr}_Q \mathscr{I}(Z).$$

*Proof.* The recorded Kraus maps are

$$|k\rangle_R \otimes |y\rangle_Y \otimes M_{k,y} D_k.$$

Their squared moduli sum to $I_{CQ}$, because $\sum_y M_{k,y}^\dagger M_{k,y} = I_Q$. This proves complete positivity and trace preservation. The score identity follows from $\sum_y yE_{k,y} = A_k$. All linear identities tensor with the identity on a reference.

For implementation in an admitted finite gate model, use the isometry

$$\psi \longmapsto \sum_y |y\rangle_P \otimes M_{k,y}\psi.$$

It extends to a unitary with a fixed blank probe. Destructive probe readout gives the stated branches. The clock is

read by its measurement bras *D_k*.

This is the complete compressed instrument of V-B [CheungVBInstrument]. It is not a new unspecified ``replacement'' for that instrument. The Shredder step is the explicit change of access in .

The bare clock identity remains

$$\mathscr{M}_C(Z) = \sum_k \mathrm{proj}\, k_R \otimes D_k Z D_k^\dagger, \qquad \mathrm{Tr}_R \mathscr{M}_C(Z) = \mathrm{Tr}_C Z.$$

It does not assert that a subsequent response measurement is nondisturbing [CheungIB,CheungEn09A].

**Failures are part of the channel**

A simple explicit failure convention is

$$\mathscr{I}_k^\nu(\rho) = \nu \mathrm{proj}\, \perp \otimes \rho + (1-\nu)\sum_y \mathrm{proj}\, y \otimes M_{k,y}\rho M_{k,y}, \qquad 0 \le \nu < 1.$$

The failure returns the actual unmodified code state at the retained-output cut. Tracing that state gives the record-only failure probability *ν*. Every outcome is included in the deterministic channel. Deleting failure trials defines another task.

The clock can be fixed at *k*, or sampled independently of the unknown code and reported. Unless stated otherwise, recovery below concerns the unknown *d*-dimensional code *Q*, not simultaneous return of an unknown $C \otimes Q$ input.

## The classical-only recovery obstruction

Use

$$d_\diamond(\Phi, \Psi) = \tfrac{1}{2}\|\Phi - \Psi\|_\diamond, \qquad d_{\mathrm{tr}}(\rho, \sigma) = \tfrac{1}{2}\|\rho - \sigma\|_1.$$

Let

$$|\Omega_d\rangle = \frac{1}{\sqrt{d}} \sum_{j=1}^{d} |j\rangle_E |j\rangle_Q, \qquad \Omega_d = |\Omega_d\rangle\langle\Omega_d|,$$

and

$$F_e(\Lambda) = \mathrm{Tr}\,[\Omega_d (\mathrm{id}_E \otimes \Lambda)(\Omega_d)].$$

The reference *E* is not decoder-accessible.

**Theorem.** Let

$$\mathscr{C}_F(\rho) = \sum_w \mathrm{tr}\,(F_w \rho)\mathrm{proj}\, w, \qquad F_w \ge 0, \quad \sum_w F_w = I_d.$$

Then

$$\sup_{\mathscr{D}} F_e(\mathscr{D}\mathscr{C}_F) = \frac{1}{d^2}\sum_w \lambda_{\max}(F_w) \le \frac{1}{d},$$

and every deterministic decoder obeys

$$d_\diamond(\mathscr{D}\mathscr{C}_F, \mathrm{id}_Q) \ge 1 - \frac{1}{d}.$$

The constants *1/d* and *1 − 1/d* are sharp over the classical-output class.

The distinct Haar-average state-return task satisfies

$$F_{\mathrm{av}}(\mathscr{D}\mathscr{C}_F) \le \frac{2}{d+1}, \qquad 1 - F_{\mathrm{av}} \ge \frac{d-1}{d+1}.$$

If an implemented channel on the same complete output interface has *d_{◇}(𝒞, 𝒞_F) ≤ δ*, then

$$d_\diamond(\mathscr{D}\widehat{\mathscr{C}}, \mathrm{id}_Q) \ge \left[1 - \frac{1}{d} - \delta\right]_+.$$

*Proof.* A decoder of a classical output prepares states *ω_w*. The Bell-overlap identity gives

$$F_e(\mathscr{D}\mathscr{C}_F) = \frac{1}{d^2}\sum_w \mathrm{tr}\,(F_w\omega_w).$$

Choose a top eigenstate independently for each *w* to obtain the equality in . The inequality uses *λ_max(F_w) ≤ tr F_w*.

Equivalently, the decoded channel is measure-and-prepare and hence entanglement breaking [HSR]. For a separable state *σ_EQ*, *Tr (Ω_dσ_EQ) ≤ 1/d*. Testing the difference from *Ω_d* with this Bell projector proves .

Measure and re-prepare an orthonormal basis to obtain pinching *Δ*. It has *F_e(Δ) = 1/d*. For *Z = ∑_j e^{2πij/d}proj j*,

$$\Delta = \frac{1}{d}\sum_{a=0}^{d-1} \mathrm{Ad}_{Z^a}.$$

The triangle inequality gives *d_{◇}(Δ, id) ≤ (d − 1)/d*, which matches the lower bound.

The Haar second-moment identity, or its direct application to each effect and prepared state, yields *F_av = (dF_e + 1)/(d + 1)* [Nielsen]. Finally apply postprocessing contractivity and the triangle inequality to the implemented channel.

This is the content of I-C's classical recovery and robustness statements, with established entanglement-breaking principles attributed [CheungIC,HSR]. The result is independent of the length or numerical precision of a finite transcript. It does not apply to while its quantum *Q*-output remains accessible.

For the binary effects , writing *B = A_k/L*, the sharper channel-specific fidelity is

$$F^{\star}_{\mathrm{record}} = \frac{1 + \frac{1}{2}(\lambda_{\max}B - \lambda_{\min}B)}{d^2}.$$

The universal floor need not be the exact optimum of this particular weak binary measurement.

## Exact recovery for the compressed cubic qubit

For a fixed setting, write the retained channel as

$$\mathscr{N}_A(\rho) = \sum_{y=\pm 1} \mathrm{proj}\, y \otimes M_y \rho M_y.$$

**Lemma.** For the positive-root instrument of ,

$$F^{\star}_{\mathrm{keep}} := \sup_{\mathscr{D}} F_e(\mathscr{D}\mathscr{N}_A) = \frac{1}{d^2}\sum_y (\mathrm{tr}\sqrt{E_y})^2.$$

Discarding the record and leaving the conditional quantum output otherwise unchanged attains this fidelity.

*Proof.* A decoder on the flagged output consists of a CPTP map for each *y*, with Kraus operators *R_{y, α}*. Its entanglement fidelity is

$$\frac{1}{d^2}\sum_{y,\alpha} \left|\mathrm{tr}\,(R_{y,\alpha}\sqrt{E_y})\right|^2.$$

For one branch, diagonalize *√(E_y)* with eigenvalues *t_j ≥ 0*, and define the Kraus-index vector

$$v_j = (\langle j, R_{y,\alpha} j\rangle)_\alpha.$$

Trace preservation gives *‖v_j‖^2 ≤ ∑_{α} ‖R_{y, α}j‖^2 = 1*. Hence

$$\sum_\alpha \left|\mathrm{tr}\,(R_{y,\alpha}\sqrt{E_y})\right|^2 = \Big\|\sum_j t_j v_j\Big\|^2 \le \Big(\sum_j t_j\Big)^2.$$

The identity decoder on each quantum branch attains the bound.

The polar-feedback mechanism underlying this formula is standard environment-assisted correction [GregorattiWerner]. Its use here does not identify the compressed observable with a continuum coupling.

### The two V-B settings

Use , and the settings

$$A_0 = c_f X, \qquad A_1 = 2c_f X, \qquad L = 4c_f.$$

Then

$$E_{k,y} = \tfrac{1}{2}(I + y r_k X), \qquad r_0 = \tfrac{1}{4}, \quad r_1 = \tfrac{1}{2}.$$

These are V-B's actual compressed cubic settings [CheungVBCubic].

**Theorem.** For *E_y = 1/2(I + yrX), 0 ≤ r ≤ 1*, define

$$\varepsilon^{\star}_{\mathrm{record}} = \inf_{\mathscr{D}} d_{\diamond}(\mathscr{D}\mathscr{C}_r, \mathrm{id}_2), \qquad \varepsilon^{\star}_{\mathrm{keep}} = \inf_{\mathscr{D}} d_{\diamond}(\mathscr{D}\mathscr{N}_r, \mathrm{id}_2).$$

Then

$$F^{\star}_{\mathrm{record}} = \frac{1+r}{4}, \qquad \operatorname{boxed} \varepsilon^{\star}_{\mathrm{record}} = \frac{3-r}{4},$$

$$F^{\star}_{\mathrm{keep}} = \frac{1+\sqrt{1-r^2}}{2}, \ \operatorname{boxed} \varepsilon^{\star}_{\mathrm{keep}} = \frac{1-\sqrt{1-r^2}}{2}.$$

With the explicit failure channel ,

$$\varepsilon^{\star}_{\mathrm{record},\,v} = \frac{3-(1-v)r}{4}, \qquad \varepsilon^{\star}_{\mathrm{keep},\,v} = (1-v)\frac{1-\sqrt{1-r^2}}{2}.$$

*Proof.* Equation gives the record fidelity. Every decoded channel has diamond error at least one minus its Bell overlap.

Prepare the *X*-eigenstate with eigenvalue *y* after record *y*. The decoded Bloch map preserves only the *X*-component and multiplies it by *r*. It is a Pauli channel with identity weight *(1 + r)/4*. A Bell input distinguishes the four Pauli errors, and the triangle inequality gives the matching upper bound *1 − (1 + r)/4*. This proves .

Lemma gives the retained fidelity. In the *X*-basis, the channel *∑_y √(E_y)ρ√(E_y)* preserves diagonals and multiplies coherences by *η = √(1 − r^2)*. It equals

$$\frac{1+\eta}{2}\mathrm{id} + \frac{1-\eta}{2}\mathrm{Ad}_X.$$

Its exact half-diamond error is *(1 − η)/2*, again by the Bell input and the triangle inequality. The fidelity optimum supplies the matching lower bound for every decoder.

For failures, the retained channel has identity weight *v* on the flagged failure branch. The branchwise fidelity optimization is independent across flags. The identity branch is already perfectly correctable. Ignoring the flags gives a Pauli dephasing channel with coherence multiplier *v + (1 − v)η*, proving the retained formula.

At record-only access, the failure effect is *vI*; its optimal contribution to Bell fidelity is *v/4*. Preparing *I/2* on failure and the stated eigenstates on success gives the Pauli channel with retained Bloch component *(1 − v)r*. Its Bell error attains the lower bound.

toprule Setting *r F_record^{⋆} ε_record^{⋆} ε_keep^{⋆}*

midrule *f 1/4 5/16 11/16 (4 − √(15))/8*

*2f 1/2 3/8 5/8 (2 − √(3))/4*

bottomrule

These exact values do not require a numerical evaluation of *c_f*: the source calibration uses *L = 4c_f*. The packet benchmark in Example gives the independently explicit choice *c_f = √(6)*.

For *r < 1*, the retained effects have rank two. The flagged pure Choi branches are then entangled, so the retained instrument is not entanglement breaking. At *r = 1* it becomes a projective measurement, and keeping the postmeasurement qubit does not restore unknown coherences. Thus retaining a residual is neither a guarantee of perfect return nor, without qualification, a guarantee of non-entanglement-breaking behavior.

For the source preparations,

$$p_k(y \mid \psi_{\pm}) = \frac{1}{2}\left(1 \pm y r_k \frac{2\varepsilon}{1+\varepsilon^2}\right).$$

Their informative record difference coexists with the strictly positive record-only recovery error.

## From joint form limits to complete-channel error bounds

**Lemma.** If $E, F \geq aI$, $a > 0$, then

$$\|\sqrt{E} - \sqrt{F}\| \leq \frac{\|E - F\|}{2\sqrt{a}}.$$

*Proof.* Put $S = \sqrt{(E)}$, $T = \sqrt{(F)}$, and $X = S - T$. Then

$$SX + XT = E - F.$$

Its solution is

$$X = \int_0^\infty e^{-tS}(E - F)e^{-tT}\,\mathrm{mathop\,d}t,$$

as follows by differentiating the integrand. The integral norm is bounded by $\|E - F\|\int_0^{\infty} e^{-2t\sqrt{(a)}}mathop\ dt$ .

**Theorem.** Use Specification , the same clock, and the same calibration $L$ for all sufficiently refined cutoffs. Write

$$\varepsilon_A = \max_k \|A_{k,\mathbf{a}} - A_k\|.$$

Suppose all limiting and regulated effects obey $E_{k, y}, E_{k, y, a} \geq aI$, $a > 0$. Then

$$d_\diamond(\mathscr{I}_{\mathbf{a}}, \mathscr{I}) \leq \min\left\{1, \frac{\varepsilon_A}{2\sqrt{2}\,L\sqrt{a}}\right\},$$

$$d_\diamond(\mathscr{C}_{\mathbf{a}}, \mathscr{C}) = \frac{\varepsilon_A}{2L}.$$

The equality in concerns these binary record channels with their common clock interface.

For

$$A_{\max} = \max_k \|A_k\| < L,$$

one may eventually use $a = (L - A_{max})/(4L)$. Combining with gives an explicit linear bound in $e(a)$.

*Proof.* The effect difference has norm at most $\varepsilon_A/(2L)$. Lemma gives

$$\max_{k,y} \|M_{k,y,\mathbf{a}} - M_{k,y}\| \leq \frac{\varepsilon_A}{4L\sqrt{a}}.$$

Use Stinespring isometries retaining an additional copy of the classical branch:

$$J\psi = \sum_{k,y} |k,y\rangle \otimes |k,y\rangle \otimes M_{k,y} D_k \psi.$$

Orthogonality of the clock blocks and the two response flags implies

$$\|J_{\mathbf{a}} - J\| \leq \frac{\varepsilon_A}{2\sqrt{2}\,L\sqrt{a}}.$$

For every referenced input state, the trace distance of the two isometric outputs is at most this norm. Partial trace proves .

For a fixed clock block let $H_k = (A_{k, a} - A_k)/(2L)$. The two record-output difference blocks on a referenced state are

$$\mathrm{Tr}_Q[(H_k \otimes I)\rho], \qquad -\mathrm{Tr}_Q[(H_k \otimes I)\rho].$$

Duality bounds their combined half trace norm by $\|H_k\|$. An input eigenvector of $H_k$ attains that bound. Choosing a maximizing clock block proves .

If $\varepsilon_A \leq (L - A_{max})/2$, every matrix norm is at most $(L + A_{max})/2$. The asserted common lower effect bound follows directly from .

V-B already proves fixed-compression diamond convergence [CheungVBCompression]. The theorem above gives an explicit rate from the form seminorm and spectral gap, and distinguishes the exact record-marginal distance from a retained-instrument bound.

**Corollary.** If an implemented complete channel differs by half-diamond distance at most $\delta$ from either ideal access cut, then its optimal recovery error differs from the corresponding ideal optimum by at most $\delta$. In particular, for $k = 0, 1$,

$$\inf_{\mathscr{D}} d_{\diamond}(\mathscr{D}\widehat{\mathscr{C}}_k, \mathrm{id}_2) \geq \left[\frac{3 - r_k}{4} - \delta\right]_+.$$

The weaker universal bound is $[1/2 - \delta]_{+}$.

*Proof.* For every decoder, postprocessing contractivity and the triangle inequality bound the change of its recovery error by $\delta$. Take infima, and interchange the two channels for the reverse inequality. Apply Theorem .

For the source cubic form, a justified allowance is the sum of the fixed-compression bound from – and any independently certified implementation error. No increasing-code or continuum apparatus limit is implied.

### Adaptive use requires complete instruments

If every selective map of two finite instruments agrees, substitution at each node of a finite adaptive instruction tree gives equal joint record laws and equal final residual channels, including references. With complete-channel errors $\delta_j$, telescoping composition gives total error at most $\sum_j \delta_j$. Classical adaptive control is included by retaining its history register throughout.

Equality of outcome effects alone does not justify this substitution, because it leaves the conditional residual maps unspecified. These are the finite-certificate distinctions of En02-B and the complete-instrument comparisons in VIII-A [CheungEn02B,CheungVIIIA]. They do not depend on a catalogue-family claim.

## The conical laboratory and an independent scalar echo

### The prescribed local Grade-S host

Prescribe

$$M_\alpha = \mathbb{R}_T \times (0,\infty)_r \times (\mathbb{R}/2\pi\mathbb{Z})_\varphi \times \mathbb{R}_z, \qquad g_\alpha = -c^2 \mathrm{mathop\,d}T^2 + \mathrm{mathop\,d}r^2 + \alpha^2 r^2 \mathrm{mathop\,d}\varphi^2 + \mathrm{mathop\,d}z^2, \quad 0 < \alpha < 1.$$

The missing singular completion locus has coordinates $(T, z)$ and is a worldsheet.

A developing chart gives

$$(T, r, \varphi, z) \mathrm{longmapsto} (cT, r\cos(\alpha\varphi), r\sin(\alpha\varphi), z).$$

V-B's response, Fourier representation, vacuum, and Newton inverse are nevertheless evaluated on an independently declared auxiliary Minkowski presentation. Only supported regular packets are interpreted through that chart [CheungVBPresentation].

The regular cone is not globally hyperbolic. For events at $r = r_{*} > 0$, times $\pm A$, with $cA > r_{*}$, their causal diamond contains a sequence at time zero with $r \mathrm{downarrow} 0$. It has no convergent subsequence in the regular manifold. This prevents an unqualified import of global globally-hyperbolic Green theory, but does not prove nonexistence of an extension-dependent Green operator [CheungGreen,BGP].

**Proposition.** Choose the same developed TT waves, scalar data, response test, curvature tests, and reporting rule in regular isometric laboratories for two prescribed cone parameters. As long as the entire retained response packet remains in those laboratories with the stated flat continuation, the TT transcript has the same law.

*Proof.* All response and Gram integrals are evaluated from the same auxiliary functions in developed coordinates. A local isometry preserves their tensor pairings and volume elements. Thus $G$, $b$, $z$, $\lambda$, and the installed reporting probabilities coincide.

Consequently a compact TT current does not automatically inherit a scalar echo's deficit sensitivity. The echo is an additional propagation module.

### Declared scalar echo data

We use a neutral scalar Friedrichs echo as an explicit analytical input, not a newly proved global cone theory. The corresponding kernel and window construction are recorded in I-C and I-B-ECHO [CheungIC,CheungEcho].

Use geometrized time $t = cT$. Fix

$$0 < r_e < r_r, \qquad R_0 = r_r - r_e, \qquad L_e = r_e + r_r, \qquad \rho(u) = \sqrt{r_e^2 + r_r^2 + 2r_e r_r \cosh u}.$$

Let *a(t)* be a nonnegative smooth pulse with integral one and compact support in *[0, T_s]*. The supplied neutral backscatter diffracted response is

$$u_{\mathrm{dif},\alpha}(t) = -\frac{1}{4\pi^2\alpha}\int_0^\infty \frac{\Phi_\alpha(u)}{\rho(u)} a(t-\rho(u))\,\mathrm{mathop\,d}u, \qquad \Phi_\alpha(u) = \frac{\sin(\pi/\alpha)}{\cosh(u/\alpha) - \cos(\pi/\alpha)}.$$

It vanishes for *t < L_e*. This is a scalar propagation input, not a TT spin-2 kernel.

Choose a compact parameter interval *J ⊂ (0, 1]* inside one non-shadow backscatter sector, avoiding *α = 1/(2n)*. Choose a direct gate *χ_d* equal to one on the complete direct pulse, and an echo gate *χ_e* supported in *[L_e, L_e + T_w]*. Require that all geometric image pulses are disjoint from the direct gate and have ended before the echo gate. These are additional arrival-window conditions. They do not follow from the existence of the TT Gram cutoff.

Define

$$W(u) = \int \chi_e(t) a(t-\rho(u))\,\mathrm{mathop\,d}t, \qquad Z_W = \int_0^{u_*} \frac{W(u)}{\rho(u)}\,\mathrm{mathop\,d}u > 0,$$

where *ρ(u_{*}) = L_e + T_w*. The strict positivity excludes a zero gate or absent overlap. Let

$$y_d = \frac{1}{4\pi R_0}, \qquad y_e = \int \chi_e(t) u_{\mathrm{dif},\alpha}(t)\,\mathrm{mathop\,d}t, \qquad s(\alpha) = \frac{y_e/y_d}{(R_0/\pi)Z_W}.$$

Substitution gives the exact conditional reduction

$$s(\alpha) = \int_0^{u_*} q(\alpha,u)\,\mathrm{mathop\,d}\mu_W(u), \qquad q(\alpha,u) = -\frac{\sin(\pi/\alpha)}{\alpha(\cosh(u/\alpha) - \cos(\pi/\alpha))}, \quad \mathrm{mathop\,d}\mu_W = \frac{W(u)\rho(u)^{-1}\mathrm{mathop\,d}u}{Z_W}.$$

The probability measure *μ_W* is independent of *α*. The kernel input is attributed to I-C; the normalization has been written explicitly to make its use checkable [CheungICWindow].

**Theorem.** Let

$$q_0(\alpha) = q(\alpha,0) = -\frac{1}{\alpha}\cot\frac{\pi}{2\alpha}.$$

Fix *u_0 > 0* and define the finite constant

$$C_J = \frac{1}{2}\sup_{\mathrm{substack}\,\alpha\in J}$$

For any admitted nonzero isolated gate with *u_{*} ≤ u_0*,

$$s'(\alpha) \le -\frac{\pi}{2} + C_J u_*^2.$$

If *κ_J = π/2 − C_Ju_{*}^2 > 0*, then

$$|s(\alpha_1) - s(\alpha_2)| \ge \kappa_J|\alpha_1 - \alpha_2|, \qquad \alpha_i \in J.$$

For *J ⊂ (1/2, 1]*, the echo vanishes exactly at *α = 1*.

*Proof.* On the compact non-shadow set, the denominator of *q* is bounded away from zero. The function is smooth in *α* and even analytic in *u* near zero. Taylor's theorem gives

$$|\partial_\alpha q(\alpha,u) - q_0'(\alpha)| \le C_J u^2.$$

Writing *x = π/(2α)*,

$$q_0'(\alpha) = -\frac{x - \sin x\cos x}{\alpha^2\sin^2 x}.$$

For *x ≥ π/2*, the numerator is at least *π/2*: its derivative is *2sin^2 x ≥ 0*. Also *α^2sin^2 x ≤ 1*, so *q_0^{'} ≤ −π/2*. Differentiate under its compact integral and use independence of *μ_W* from *α*. The mean value theorem proves .

For *1/2 < α < 1*, the integrand in is strictly positive. At *α = 1* it is identically zero. Use *Z_W > 0*.

The calculation rederives a sufficient short-window condition within I-C's explicit scalar setup [CheungICWindow]. It is not uniform across shadow transitions. At other pure-image openings the diffracted weight can vanish, so the zero-deficit interpretation is restricted to the stated sector.

### Finite report laws and their error budget

Let

$$p(s) = \frac{1 + \tanh(\gamma s/\sigma)}{2}, \qquad \gamma \neq 0, \quad \sigma > 0,$$

and report *1*, *0*, $\perp$ with probabilities

$$P_\alpha(1) = (1 - \nu)p(s(\alpha)), \quad P_\alpha(0) = (1 - \nu)(1 - p(s(\alpha))), \quad P_\alpha(\perp) = \nu.$$

As with , this requires a supplied preparation of the echo value; it is not an unknown-field detector construction.

**Corollary.** Assume $|s(\alpha)| \le S$ on $J$, and define

$$\ell = \frac{|\gamma|}{2\sigma}\operatorname{sech}^2(|\gamma|S/\sigma), \qquad L_p = \frac{|\gamma|}{2\sigma}.$$

Suppose supplied echo values have errors $\eta_i$, and implemented report laws have additional errors $\delta_i$ in total variation. Under Theorem ,

$$\mathrm{TV}(\widehat{P}_{\alpha_1}, \widehat{P}_{\alpha_2}) \ge [(1 - \nu)(\ell\kappa_J|\alpha_1 - \alpha_2| - L_p(\eta_1 + \eta_2)) - \delta_1 - \delta_2]_+.$$

*Proof.* On the true value interval, $|p^{\prime}| \ge \ell$; globally $|p^{\prime}| \le L_p$. The ideal total variation is $(1 - \nu)|p(s(\alpha_1)) - p(s(\alpha_2))|$. Apply , then subtract preparation and implementation allowances by the triangle inequality.

One may append this echo label to the TT transcript. That joint report is deficit-sensitive because of the additional scalar module, not because a scalar kernel has become a tensor-current theorem. Its law remains classical, so it is not a quantum-return decoder.

## Why the proposed dynamical-host identification is missing

### The version-qualified I-D comparison

The supplied I-D-v5 record reports a Host-B ball-arithmetic resonance census: 44 simple zeros in the stated box

$$\mathrm{Re}\,\omega \in [0.05, 2.5], \qquad \mathrm{Im}\,\omega \in [-0.75, -0.005],$$

with enclosures to $10^{-12}$ and

$$|\mathrm{Im}\,\omega| \ge 0.12816$$

for those zeros [CheungID]. This is attributed as a documentary source record. No Arb execution, winding-number calculation, Rouché-disk reconstruction, or independent validation is claimed here.

The same supplied record explicitly refuses transfer of the I-B-ECHO kernel to Host B, identification of the conical state with a Host-B vacuum, and use of a pure quasinormal-mode train as the full propagation law [CheungID]. Consequently Section cannot be relabelled a Host-B echo evaluation.

A local laboratory could be installed on another spacetime only after its metric, chart, supports, proper-time calibration, couplings, and propagation dictionary were supplied. An abstract finite channel is portable as algebra. Its continuum interpretation is not portable without those data.

### The residual-gauge equation changes

**Proposition.** Let $G(g)$ denote the Einstein tensor of a smooth background. For any smooth vector field $\xi$,

$$G_g^{(1)}(\mathscr{L}_\xi g) = \mathscr{L}_\xi G(g).$$

Thus pure-gauge metric perturbations need not lie in the kernel of the metric-only linearized equation on a nonvacuum background.

With the curvature convention for which $[\nabla_a, \nabla_b]v^c = R^c{}_{dab}v^d$, the covariant de Donder operator satisfies

$$(D_g K_g \xi)_b = \nabla^a \nabla_a \xi_b + R_b{}^c \xi_c.$$

The flat componentwise vector-wave equation is therefore not automatically the Host-B residual equation.

*Proof.* Naturality under the flow $F_s$ of $\xi$ gives

$$G(F_s^* g) = F_s^* G(g).$$

Differentiate at $s = 0$ to obtain . For , expand the divergence of

$$(K_g\xi)_{ab} - \tfrac{1}{2} g_{ab}\mathrm{tr}_g\,(K_g\xi) = \nabla_a\xi_b + \nabla_b\xi_a - g_{ab}\nabla^c\xi_c$$

and commute the two derivatives on the covector.

A coupled Einstein–matter gauge transformation can transform the source as well. That is another equation-space problem. Neither nor a metric source classification supplies the required coupled system.

On Host A, I-D's supplied pulse-shell statement is Segre type II where the indicated coefficient inequality holds, together with NEC violation throughout the shell and exclusions of the tested Maxwell, anisotropic-fluid, and Letelier-cloud source classes [CheungID]. These are source-model exclusions. They do *not* imply that a test Klein–Gordon equation cannot be posed there: the principal symbol of $\Box_g - m^2$ is Lorentzian independently of a stress tensor's NEC. Any wave theorem still needs its ordinary domain and global Cauchy hypotheses [BGP].

Therefore NEC violation is not the reason the flat residual proof fails to transfer. The missing background, gauge, and inverse identifications are.

### A Wronskian zero need not appear in a selected report

**Lemma.** Consider an independently specified analytic radial problem

$$P_\omega = -\partial_x^2 + V(x) - \omega^2$$

with analytic left and right outgoing solutions $u_L$, $u_R$ and Wronskian $W = u_L u_R' - u_L' u_R$. Where $W \neq 0$, its outgoing Green kernel is

$$G_\omega(x, x') = -\frac{u_L(x_<, \omega) u_R(x_>, \omega)}{W(\omega)}.$$

For fixed compact source $j$ and report test $\chi$, put

$$\mathscr{H}(\omega) = \mathrm{i}\int \chi(x) G_\omega(x, x') j(x')\,\mathrm{d}x\,\mathrm{d}x'.$$

At a simple zero $\omega_*$ of $W$, the report has residue

$$\mathrm{Res}_{\omega_*}\mathscr{H} = -\frac{N(\omega_*)}{W'(\omega_*)}, \qquad N(\omega) = \mathrm{i}\int \chi(x) u_L(x_<, \omega) u_R(x_>, \omega) j(x')\,\mathrm{d}x\,\mathrm{d}x'.$$

It need not have a pole if $N(\omega_*) = 0$.

*Proof.* The kernel solves the homogeneous equation off $x = x'$. Its first-derivative jump is $-1$, which gives $P_\omega G_\omega = \delta$. The residue follows from the quotient of analytic functions. A zero numerator cancels the proposed pole.

This lemma is conditional and uses no Host-B numerical data. To make the residual wave a probe of that census would require the same radial equation, boundary conditions, spectral normalization, source coupling, and nonzero report numerator. They have not been supplied.

Moreover a smooth compact time window makes the Fourier transform of a windowed distribution entire. Indeed, derivatives with respect to complex frequency can be taken under pairing with its compactly supported exponential test. A finite window may reveal a resonance-shaped dependence; it does not itself have the meromorphic poles of an infinite-time outgoing resolvent.

Resonance-derived clock labels may be prescribed externally if supplied as classical numbers. That does not establish a resonance-selected quantum clock dynamics or identify any residual wave with a counted zero.

## Limits of finite tests and of host comparisons

**Proposition.** For any finite family of real compact smooth tests $f_1, \ldots, f_n$ in an open region $O$, there are compactly supported distributions with identical values on every $f_j$ and different wavefront sets.

*Proof.* Discard dependent tests, and let $G_{ij} = \int_O f_i f_j$. The resulting Gram matrix is positive definite. Set

$$h_j = \sum_k (G^{-1})_{jk} f_k, \qquad \int h_j f_i = \delta_{ij}.$$

Choose $x \in O$ and define

$$T = \delta_x - \sum_j f_j(x) h_j.$$

Then $\langle T, f_i \rangle = 0$ for every $i$. The distribution $T$ is singular at $x$, because subtracting a smooth function cannot remove the delta singularity. Its wavefront set is nonempty. The zero distribution gives the same finite values and has empty wavefront set.

This does not contradict injectivity on an explicitly finite-dimensional parameter family, such as the TT plane. Nor does finite-precision closeness of two exact report vectors prove equality or non-injectivity.

The following comparisons remain separately typed:

• I-B-G's scalar Green operators require their declared self-adjoint extensions and supported arrival-window hypotheses; they are not the auxiliary Newton inverse [CheungGreen].

• I-B-G-S's vector and tensor source-test identities concern their own bundle domains. A scalar Friedrichs kernel is not a spin-2 assembly [CheungSpin].

• I-B-VP's local Hadamard and Friedrichs-state statements are for its declared conical scalar theory, not a Host-B throat vacuum or V's unspecified continuum apparatus [CheungVP].

• Em02-E's quadratic kernel and relational lapse retain their background, inverse, and residual-gauge hypotheses. They are comparisons, not repairs of the present Ward defect [CheungLapse].

• Prob02-A and the supplied descriptions of Prob03-A concern separately typed reductions and completion questions. A componentwise scalar declaration of a metric line is not I-B-G-S's tensor construction or the inherited full graph [CheungProb].

• The Oai265, Oai272, Oai276, and OpenAI-family descriptions are documentary records only. No family identifier supplies a continuum encoder, echo kernel, clock limit, or proof of same-host equality [OpenAIRecords].

The relevant identities and error estimates in this paper are proved directly. None of these comparisons closes a missing analytical premise.

## Entropy, thermal accounting, terminal continuations, and resources

### Append-only classical entropy

**Proposition.** Let $R_n = (X_1, \ldots, X_n)$ be a finite classical history including failures and padded stop symbols. For a fixed initial preparation and unconditioned law,

$$H(R_{n+1}) - H(R_n) = H(X_{n+1} \mid R_n) \geq 0.$$

Equality holds precisely when the new label is almost surely a function of the old history.

*Proof.* Trace preservation of the full continuation preserves the old-history marginal. Apply the Shannon chain rule. Classical conditional entropy is the average entropy of the conditional probability laws, and vanishes exactly when those laws are point masses.

This is I-C's append-only transcript statement [CheungIC]. A selected marginal, lossy summary, or postselected record is another object. Quantum radiation entropy can decrease as a larger entangled quantum system is retained; the entropy of this same diagonal append-only transcript cannot exhibit that mechanism. No Page curve is computed.

### The conditional finite-reservoir equality

**Proposition.** Let a finite complete nonreservoir system $M$ and a finite reservoir $B$ start in

$$\rho_M \otimes \tau_B, \qquad \tau_B = Z^{-1} e^{-\beta H_B}, \quad \beta > 0.$$

Let $\omega_{MB} = U(\rho_M \otimes \tau_B)U^{\dagger}$, and define $Q_B = Tr\, H_B(\omega_B - \tau_B)$. With natural-log entropies,

$$\beta Q_B = S(\rho_M) - S(\omega_M) + I(M:B)_\omega + D(\omega_B \| \tau_B).$$

*Proof.* The Gibbs formula gives

$$D(\omega_B \| \tau_B) = \beta Q_B - S(\omega_B) + S(\tau_B).$$

Initial independence and unitary invariance of total entropy give

$$I(M:B)_\omega = S(\omega_M) + S(\omega_B) - S(\rho_M) - S(\tau_B).$$

Eliminate the bath entropy difference.

This is the standard finite-reservoir identity used by I-C [ReebWolf,CheungIC]. A positive complete nonreservoir entropy decrease implies the corresponding positive heat lower bound. Destructive readout alone specifies neither that entropy decrease nor the Hamiltonians, bath, switching work, or endpoint interaction energies.

For example, degenerate equal-dimensional systems with $H_M = H_B = 0$, followed by SWAP with a maximally mixed reservoir, have $Q_B = 0$. Information may become inaccessible at one cut without a universal strictly positive readout heat. This relocates information; it is not erasure of the complete closed state with no other output.

**Terminal continuations do not follow from the report**

Suppose the complete output is $\sum_w \mathrm{proj}\, w \otimes \sigma_w$. Two deterministic continuations are:

$$\mathscr{T}_0(\mathrm{proj}\, w \otimes \sigma) = \mathrm{proj}\, w \otimes \sigma, \qquad \mathscr{T}_1(\mathrm{proj}\, w \otimes \sigma) = \mathrm{proj}\, w \otimes (\mathrm{Tr}\, \sigma)\omega_0.$$

They have the same retained report law, but different quantum endpoints for a nontrivial residual. A third continuation can append a fresh random label. All are CPTP. Thus the report interface does not select a terminal quantum state, reservoir history, gravitational endpoint, or explosion. Choosing a terminal channel is additional dynamics.

**Scheduled peak and external storage**

In an admitted exact finite gate model, let the input clock have $q$ qubits and the response code $p$ qubits. The following schedule implements :

• hold the input $C \otimes Q$, using $q + p$ live qubits;

• destructively read the clock and retain its classical code;

• allocate one blank probe, apply the selected finite measurement isometry, and destructively read the probe;

• return $Q$ and all classical labels. With no additional synthesis workspace, its elementary scheduled peak is

$$p + \max\{q, 1\}.$$

If clock and probe are instead kept live simultaneously, the corresponding upper bound is $q + p + 1$. For the cubic example $p = q = 1$, these schedules use peaks two and three respectively.

These are different schedules, not a claim of unrestricted decoder or apparatus optimality. A global stock of fresh systems, supplier holdings, transport registers, environments, and synthesis ancillas requires its own ledger. The untouched reference is not an operational workspace. Finite-channel correctness does not erase storage in the actual schedule [CheungEn02B,CheungEn03A].

Assigning causal locations to these finite gates is also a separate certificate. Pulling observables backwards through a supplied local network bounds their dependence by its scheduled ancestors, because every channel adjoint is unital on unused factors. This does not localize a Newton inverse or construct a compact relativistic field coupling.

## Release, unresolved objects, and the unchanged standing ledger

**Theorem.** For the supported flat response packet, each declared separating TT plane, and each form/carrier package satisfying Specification :

• the complete fixed-time Ward defect retains the initial-surface terms; the residual witness remains a classical obstruction on every named space containing it;

• compact curvature currents represent the response on the chosen plane and yield the explicit supplied-value

transcript , with conditioning and report errors –;

• the compressed matrices define the complete instrument , with actual conditional residuals, failures, and untouched references;

• only after explicit quantum discard is the accessible output classical-only, with the recovery floor and its robust form ;

• the compressed cubic qubit has the exact recovery values –; their cutoff and implementation errors are controlled by Theorem and Corollary ;

• a separately declared conical scalar kernel supplies the conditional echo report , without becoming a TT current, a Host-B kernel, or a quantum-return decoder.

*Proof.* Propositions – prove (i). Lemma , Theorem , and Propositions – prove (ii). Theorem and prove (iii). Theorem proves (iv). Theorems and , with Corollary , prove (v). Theorem and Corollary prove the conditional assertion (vi). None of these proofs constructs the missing host-transfer maps of Section .

**Concrete completion status**

toprule Requested object Ending in V-DST

midrule TT-plane Shredder transcript Constructed for the declared plane and supplied-value interface, with explicit errors

Cubic transcript recovery obstruction Constructed; the channel-specific exact error is stronger than the universal floor

Fixed-compression joint cutoff control Quantified complete-channel bound proved from the printed form hypothesis

Conical short-window report Conditional evaluation from a declared scalar kernel; not an independently constructed global Green theorem

Same TT and echo window identification Not asserted; the two support and arrival certificates differ

Host-B residual response and echo evaluation Not supplied; background, gauge, propagation, source, and report identifications are missing

Host-A source interpretation Not supplied; typed source exclusions are not scalar-wave nonexistence

Thermal or terminal prediction from readout Underdetermined without additional implementation dynamics

bottomrule

**The separate characteristic programme**

V's one-cross first retarded scalar coefficient and its separate cubic Newton–wave form do not define the inherited double-cross characteristic composition. The supplied analytic records distinguish historical H2 in XIV-H, the constructed I2 internal-amplitude module in XIV-I, and the still-unconstructed complete joint map at I3/J2 [CheungAnalytic].

The technical XV-B-v2 manuscript supplies relative-lifting and extension interfaces; it does not thereby activate the downstream inherited quantum-admission exit. Its existence must not be denied by the shorthand ``XV-B is not opened."

For the required complete coefficient, the same-object chain still requires a full joint map, a joint section and controlled remainder, transverse estimates, contact compatibility, output wavefront control, and normalization/admission. No finite transcript proves one of those absent distributional constructions.

**Standing boundary of this release.**

$$\boxed{\begin{array}{c} \mathrm{O.1} = \texttt{NOT_CLOSED}, \\ \text{XVI-N is not discharged by V-DST,} \\ \text{the downstream XV-B admission exit is not opened,} \\ \text{no inherited characteristic quantum coefficient is admitted,} \\ \text{the full I3/J2 map is not constructed,} \\ \text{the last reading bar remains open.} \end{array}}$$

The historical H2 statement remains a statement about XIV-H; it is not used to withdraw XIV-I's narrower I2 construction.

Dense-TT representability, an adiabatic limit, higher causal products, a local quantum metric field, a global intrinsic reformulation of V on the cone, an intrinsic Newton inverse, Host-B echo transfer, and a compact continuum acquisition apparatus are not constructed.

There is no Grade E, Einstein dynamics, gravity-generated entanglement test, Page curve, holographic dictionary, or spacetime-emergence theorem. These are scope limits, not universal nonexistence claims.

appendix

## Debugging the proposed conversion

begingroup 1.12 toprule Proposed step Correction

midrule endfirsthead toprule Proposed step Correction

midrule endhead bottomrule endfoot

Seat the unchanged conical laboratory on I-D's Host B. An abstract finite channel can be installed after a new geometric and implementation contract is supplied. No isometric, field-theoretic, or inverse-preserving identification is currently supplied.

Evaluate the conical apex echo on Host B. I-D explicitly refuses that kernel transfer. The scalar echo calculation here remains on its prescribed conical Friedrichs model.

The flat residual wave probes the counted Wronskian zeros. A same radial operator, boundary condition, coupling, nonzero numerator, and propagation identification are required. A zero can be invisible to a selected source/report pair.

A finite time window has the outgoing resolvent's poles. Its compactly windowed transform is entire. Resonance-shaped finite data and meromorphic resolvent poles are different objects.

NEC violation excludes the residual-wave construction. It excludes only the stated source classes under the source theorem's hypotheses. It does not remove the Lorentzian principal symbol of a scalar wave equation.

The TT-plane current distinguishes deficits because the scalar echo does. Identical developed local TT packets can have identical report laws for different deficits. The nonlocal scalar echo is an additional module.

The TT Gram support is already an image-isolated echo window. One is a spacetime curvature-separation support; the other is an arrival-time gate with pulse and image exclusions. Both require their own certificates.

Destructive clock readout makes the whole output classical. The clock is consumed, but V-B's response qubit survives. Only the explicit trace of that quantum output makes the accessible channel classical-only.

The universal $1 - 1/d$ floor is the exact cubic optimum. For V-B's two qubit settings the exact record-only errors are $11/16$ and $5/8$, not merely $1/2$.

Keeping the residual returns the unknown qubit exactly. The exact retained errors are $(4 - \sqrt{(15)})/8$ and $(2 - \sqrt{(3)})/4$.

A cubic form can be exponentiated before choosing an operator. A form theorem does not supply a self-adjoint generator. The construction compresses the form first and measures the resulting Hermitian matrix.

Fixed finite form convergence gives a continuum instrument. It gives the same-target bound for one fixed code and one fixed calibration. Uniformity over increasing codes is absent.

Agreement on degree-two expectations means agreement for every measurement involving degree-two observables. Only the stated polynomial form expectations agree. Nonlinear functional calculus and entire outcome laws are additional questions.

A finite report can determine a general wavefront set. Proposition gives exact equal finite values with different singularity data.

Append-only entropy monotonicity is a radiation Page curve. The entropy is that of the complete retained classical log. Quantum radiation entropy is another state function.

Readout entails positive heat or an explosion. Equation requires the complete thermal implementation. Terminal continuations remain independent choices.

H2 remains the missing amplitude in every later version. Historical H2, constructed I2, unresolved full I3/J2, and technical relative-lifting interfaces must be kept version- and object-qualified.

endgroup

## Declarations

**Authorship.** The author line is Ngo Cheung, as requested. Citation or retention of material does not assign authorship of external articles or OpenAI catalogue material.

**Provenance.** The public V, V-B, I-B, I-C, and Philosophy of Enter records, and relevant individual passages, were consulted. The attempted full I-D retrieval did not yield an inspectable complete record through the consulted interface. The I-D-v5 comparisons are therefore attributed to the version-qualified excerpts supplied with the request, not to an independent full-text or numerical audit.

**Novelty.** The raw-current, residual-wave, curvature-dual, and compressed cubic constructions are attributed to V and V-B. The classical-output obstruction, outcome-conditioned recovery mechanism, and thermal equality are established principles. The contributions claimed here are the explicit curvature-report conditioning interface, quantitative form-to-complete-channel estimate, exact access-dependent evaluation of V-B's cubic pilot, and corrected host-transfer audit. No literature-wide priority claim is made.

**Analytical scope.** The native Newton–wave form estimate and witness are explicit input data, not independently reconstructed kernel theorems in this paper. No retarded, gauge, vacuum, or echo object is transferred to Host B by citation alone. No characteristic coefficient is admitted.

**Implementation.** The finite instrument is exact in the admitted finite gate model. Its matrix entries and supplied preparations are model inputs. A continuum acquisition, local field coupling, hardware synthesis, or experimental exclusion is not claimed.

**Verification.** This file uses an internal bibliography and no external figures. Two pdfLaTeX passes are intended. No successful compilation, proof-assistant verification, independent symbolic computation, Arb execution, physical implementation, peer review, or journal acceptance is asserted.

**Assistance.** AI assistance was used for source consultation, mathematical consistency analysis, drafting, and preparation. It is not independent verification.

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