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I-C-Th-CERT-v6: A Coefficient Certificate for the Thermal Bill

Injectivity in the inverse temperature, exact worst-case errors, the complete qubit implementation fibre, the energy-origin fibre, the dichotomy for fixed implementations, the radius lemma, and the conserved corrected fibre

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Abstract

This is version 6 of the standalone certificate sheet I-C-Th-CERT. It contains version 5 (I-C-Th-CERT-v5, which contains versions 4, 3, 2 and 1; all stay untouched) and adds the items of request t268u (no plan was attached), superseding version 5 by addition; errors of earlier versions found in version 6 are recorded in Section. The parent sheet I-C-Th (latest version I-C-Th-v1) is cited as a source record only and is not revised. The thermal coefficient is the inverse temperature β of the reservoir preparation, a supplied input. On the parent's spectator witness, with the visible channel, the spectator Hamiltonians and the energy-conserving implementation all fixed, the designated-reservoir energy gain Q_L(β) = ε/(1 + e^{−βε}) is strictly increasing, hence injective, so no rule of admitted data alone reproduces the named heat for two values of β. The plan's generic phrase ``infinite worst-case error'' is false for the energy gain: the best admitted-data rule has worst-case error exactly ε/4, and every finite reservoir has bounded energy gain. It is true for the bill in entropy units, βQ_L, which is unbounded. Injectivity holds on the witness family, not for every implementation: the identity implementation has Q_L ≡ 0. Both points are recorded as plan corrections. No temperature is derived and no quantum coefficient is admitted; the cone and its deficit stay inputs. New in version 2: (i) the finite balance βQ_B = ΔS_M + I + D holds for every unitary and every β, so it selects nothing (vacuity); (ii) with the admitted channel data and β fixed, the identity and the swap give bills 0 and ε/(1 + e^{−βε}), so no rule from those data is correct on the pair (two-point minimax error exactly half the swap bill); (iii) the bill and β are interchangeable data, so a named temperature enters only as a supplied input, and the bill is not a horizon temperature; (iv) the bill is invariant under H_B ↦ H_B + cI while absolute reservoir energies shift, so it is a relative energy and not a vacuum-energy calculation; (v) for every fixed finite implementation, either the bill is constant in β or no admitted-data rule reproduces it, and the best worst-case error is exactly half its range, at most the spectral width. New in version 3. (i) Over all energy-conserving spectator unitaries the bill is s ε/(1 + e^{−βε}) with s ∈ [0, 1] arbitrary; at fixed β the exact minimax error is half the swap bill, with U and β both omitted it is ε/2, and on that larger family the bill no longer determines β: injectivity belongs to the specified witness. (ii) The energy bill has finite worst-case error and βQ infinite. (iii) Under H_B → H_B + cI, an absolute reservoir energy has exact two-point minimax error |c_1 − c_2|/2 on the shift-invariant reduced datum and infinite worst-case error over c ∈ ℝ. (iv) Documentary readings of VC-OB-1, Big01-A and Red06-G-DSS-CERT-v2, and a correction: the finite balance is an entropy identity, not a Bell/Choi sandwich. No version-2 statement was found to be false. New in version 4. (i) A radius lemma: a constant rule has finite worst-case error exactly when the target range is bounded, and then the error is half the range. (ii) Of the named quantities compared, Q_L and the error 1 − 1/(2 + 2cosh βΔ) of a thermal replacement are injective and bounded (finite error), while βQ_L and the de Sitter labels T^{(varkappa)}, S^{(varkappa)} are unbounded (infinite error); so Red06's thm:RC-coef has the form of the βQ_L statement, not of the Q_L statement (plan correction). (iii) The curvature tensors displayed in VC-OB-1-CERT-v2 have nonzero divergence in that sheet's own convention (exact computer-assisted check), so ``enlarges the fibre by curvature counterterms'' describes the intended tensors only (plan correction); this matches Hawk07 CERT v3's correction of the identical display. (iv) The cross-reference ``the hosts and the named quantities differ'' is false inside the de Sitter group (DS-OB-1-CERT, Red06-G-DSS-CERT and Big01-A share DSS_H). One version-3 error is recorded. New in version 5. (i) The corrected curvature-squared tensor E^{(1)} is conserved; the version-2 display satisfies ∇^{μ} ^{(1)}H_{μν} = 4R_{νλ}∇^{λ}R; and E^{(1)}, E^{(2)} and both displayed tensors vanish on Einstein regions. (ii) Of the three parts of the enlarged-fibre proposition of VC-OB-1-CERT-v2: the negative part (a) survives through the

c_0-subfamily; (b) survives; and (c) survives qualitatively, with the values −360 and −120 (computer-assisted). The conservation of E^{(2)} stays partial. (iii) Readings of VC-OB-1-CERT-v3, DS-OB-1-CERT-v3, Red06-G-DSS-CERT-v4 and Hawk07-F-CERT-v3. No version-4 error was found (Section). New in version 6. (i) E^{(2)} is divergence-free for every metric (hand proof), so every member T + c_0g + c_1E^{(1)} + c_2E^{(2)} of the corrected fibre is conserved, and the version-5 proviso is removed. (ii) On the radiation metric η^2(− dη^2 + dx^2), which is not Einstein, E^{(1)} = 0 and (computer-assisted) E^{(2)} = 0: the Einstein condition is sufficient, not necessary, for the curvature-squared directions to drop out. (iii) Readings of VC-OB-1-CERT-v4, Hawk07-F-CERT-v4, DS-OB-1-CERT-v4 and DSS CERT v5; one version-4 reading is qualified (Section). (iii) The version-2 displays read in the two curvature-sign conventions give, respectively, the relations of Theorem (b) and the corrected tensors themselves, so the version-5 relation and the opposite-convention reading of VC-OB-1-CERT-v4 are both correct (Proposition). All proofs are local; the parent, Big01-A VC-OB-1, VC-OB-1-CERT-v2 and Red06-G-DSS-CERT-v2 are source records, not premises. No quantum coefficient is admitted. Host C is not created; Host A and Host B stay separate. O.1 stays NOT_CLOSED. XVI-N is not discharged (N-Ins.4 unresolved), and there is no Route-B successor. XV-B is not opened. H2, I3 and T3 stay unresolved; J2 stays Unresolved. U6-sel is not moved. Res02-A Q1–Q4 and A1–A2 stay open. The last reading bars (quantized observable, no external clock) stay open. No Einstein dynamics, derived metric, spacetime emergence, external-clock removal or Page curve is claimed. Gate 0 stays NOT_SUPPLIED, and thm:J is not substituted. Continuum acquisition stays a negative certificate. No compilation is asserted. Citations identify source records only; no proof transfer. Authorship requires confirmation. Nothing is pushed or registered.

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Parent, sources and scope

Previous version. I-C-Th-CERT-v1 (sha256 fcbcd53732db81b630c831659c412dbc9bc00be8f789fafdee99727c370b3642) is retained in Sections – and in the plan audit of plan t256u; the file itself is not edited.

Version 2. I-C-Th-CERT-v2 (sha256 53d915f44ac2257646eeb0bc1489deacc4d7c5b071ab9d0c9ef56ad54981537b) is retained in Sections – and in its plan audits; Section was new in version 3. The file I-C-Th-CERT-v2 itself is not edited.

Version 3. I-C-Th-CERT-v3 (sha256 fabc1c5c331ecdf36372e7885286db4c28c2d8d9d236720dc19b84c3059a5c76) is retained in the sections before Section and in its plan audits; Section and the plan-t266u audit were new in version 4. The file I-C-Th-CERT-v3 itself is not edited.

Version 4. I-C-Th-CERT-v4 (sha256

788fa5aa63dde75aac0ce424de32232b9ed684240711049e6d869d7c7f6cf02e) is retained in the sections before Section and in its plan audits; Section and Section were new in version 5. The file I-C-Th-CERT-v4 itself is not edited.

Version 5. I-C-Th-CERT-v5 (sha256 caa290f8dad7b6f56809947eb4b9e5a8a2f77fd56642add01de0265224a85c63) is retained in the sections before Section and in its plan audits; Section and Section are new. The file I-C-Th-CERT-v5 itself is not edited.

Parent. The parent sheet is I-C-Th; its latest version, I-C-Th-v1 (sha256 3d8d2a76deea9469326a2fc864368c9503eb93acea792787eb45adc4610e3f60), was read by read-only retrieval and is a source record [Parent]. Its implementation package is I-C-Th-v1 spec:package, its spectator witness I-C-Th-v1 thm:underdetermination, and its finite thermal balance I-C-Th-v1 thm:thermal. The witness computation needed here is restated and checked in Section . The parent stays untouched; this sheet is not a version of it.

Other source records. Big01-A version 5 (sha256 e1160613ea8e02b37fb45954fe677d89f5fa7cca90062d42b68973b03a2bff1d) is cited for context only [BigA]: Big01-A prop:Dyncert and Big01-A thm:Bthermal as patterns. VC-OB-1 version 5 (sha256 c9d821b4db97cb384fa7c4e5d9a1d44791f989c61625d202586ab689e9091bc1) is cited for the relative-energy pattern [VC]. New in version 3: VC-OB-1-CERT-v2 (sha256 3d9d18420e3ef7c1d4a21e833b0e31d5f997aad8cb149d95653012a3055e3e94; v1 573eef3843baa8f541b7ae15cb57a41d40ac5f7a1bd69b4347bb2ddc2b1dcb10 also checked) and Red06-G-DSS-CERT-v2 (sha256 a20c6b869655a31cd36b24db7e6293f480247395eefe6bbb34fc15f57e3fe36f; v3 b8b9ef6f7bca70f66fd8f96b1bd30ee8957939ac04b80205c997cfc3223522a7 also checked). None is a premise. New in version 4: Red06-G-DSS-CERT-v3 (sha256 b8b9ef6f7bca70f66fd8f96b1bd30ee8957939ac04b80205c997cfc3223522a7), the version named by the plan; Red06-G-DSS-CERT-v4 (574d8abfdcd620476e8054092bce4323652afd03740ceb917a165798bc653ebc) is newer, with the cited statements unchanged. DS-OB-1-CERT-v2 (748b382d5959123890ac320e22295c3d87609b3da73496cc85cdbfbabde2633f). Hawk07-F-CERT-v3 (2280220e1bddd21e787032d88903764932f23d06bc5100722b08891a9c536dd6), for its correction of the version-2 Definition def:v2-H. VC-OB-1-CERT-v2 as above (only v2 of the OB sheets is delivered; their v3, in preparation elsewhere, was not read). None is a premise. New in version 5: VC-OB-1-CERT-v3 (sha256 502f6e5ebcc9bbe8906026bc539b513afe9cff04efd1bd75aadc7141d868842d), newest delivered, superseding the VC-OB-1-CERT-v2 cited above; DS-OB-1-CERT-v3 (07b600a11b5ec1661b651f74d473d270aa6e114463da94f051c630dd7b1758ea); Red06-G-DSS-CERT-v4 (574d8abfdcd620476e8054092bce4323652afd03740ceb917a165798bc653ebc); Hawk07-F-CERT-v3 as above. Newer versions of Hawk07 CERT (version 4), of the OB CERT sheets (version 4) and of DSS CERT (version 5) are being built concurrently and were not read. None is a premise. New in version 6, each verified against its delivery manifest: VC-OB-1-CERT-v4 (sha256 f9802da66896159503132b736164016c1d06d2a6530bbbc06cb4ad3af0256387); Hawk07-F-CERT-v4 (sha256 3b4eef32040e7f3aad9766523b6c5deff83c9679fcd5924d3b93f5b110221e63); DS-OB-1-CERT-v4 (sha256 0b5b86f87f91503ba9e96cf221b2ef96a4b4e96e3f27489336eb2b89848463c6); Red06-G-DSS-CERT-v5 (sha256 e4a1b02552c138b8f9f009f2e71e391825ad0014f717b43f96883c445605213a); V-DST-DSS-CERT-v5 (sha256 4133961f566c059c22054b5922423d1ff94cb0d1c888ca353a7c143bba1541be). None is a premise. Second wave read in version 6: DS-, VC- and PG-OB-1-CERT-v5, Hawk07-A/F/H-CERT-v5 and En08-ST/Red06-G/V-DST-DSS-CERT-v6, verified against their manifests and cited by sha256 in Section as source records only.

Standing ledger (verbatim). No quantum coefficient is admitted. Host C is not created; Host A and Host B stay separate. O.1 stays NOT_CLOSED. XVI-N is not discharged (N-Ins.4 unresolved), and there is no Route-B successor. XV-B is not opened. H2, I3 and T3 stay unresolved; J2 stays Unresolved. U6-sel is not moved. Res02-A Q1–Q4 and A1–A2 stay open. The last reading bars (quantized observable, no external clock) stay open. No Einstein dynamics, derived metric, spacetime emergence, external-clock removal or Page curve is claimed. Gate 0 stays NOT_SUPPLIED, and thm:J is not substituted. Continuum acquisition stays a negative certificate. No compilation is asserted. Citations identify source records only; no proof transfer. Authorship requires

confirmation. Nothing is pushed or registered.

Plan refusal lines. Ledger refusal: no temperature derived, no quantum coefficient admitted, cone and deficit stay inputs. Host stays prescribed, labels stay named. No finite Hilbert space, temperature, or Einstein dynamics derived. None imports Big01-A or any other sheet as a premise. The certificate is a documentary separation: it does not discharge O.1, Gate 0, XV-B, J2, U6-sel or any standing gate, and it does not create Host C. This sheet revises no other sheet.

Authorship. The title page names Ngo Cheung. Authorship requires confirmation. No compilation is asserted.

Admitted data and the thermal coefficient

Definition. The *admitted data* $\mathfrak{A}$ of the spectator witness of the parent (I-C-Th-v1 thm:underdetermination), restated here, are: the visible implementation and its selected input–output channel; the spectator qubits W, L with $H_W = H_L = \varepsilon proj\ 1$, $\varepsilon > 0$; the initial excited state of W; the energy-conserving implementation $SWAP_WL$; and the designation of L as reservoir. The *coefficient family* is $\{\mathfrak{A}_{\beta}: \beta \in (0, \infty)\}$, where $\mathfrak{A}_{\beta}$ completes $\mathfrak{A}$ by the Gibbs preparation $\tau_L(\beta) = (1 - p)proj\ 0 + pproj\ 1$, $p = (1 + e^{\beta\varepsilon})^{-1}$. An *admitted-data rule* for a named quantity is any map that assigns a real number to $\mathfrak{A}$ alone.

par *Does not imply*. The definition names data only. It does not imply that β is derived from anything; β is the inverse temperature of the reservoir preparation, item (3) of the parent's package I-C-Th-v1 spec:package, and stays a supplied input. par

The admitted data do not contain β: every member of the family has the same visible channel, the same spectator Hamiltonians, and the same unitary.

The certificate

Theorem. On the coefficient family of Definition :

• *(Injectivity.)* The designated-reservoir energy gain is

$$Q_L(\beta) = \frac{\varepsilon}{1 + e^{-\beta\varepsilon}},$$

strictly increasing in β, hence injective on $(0, \infty)$, with range $(\varepsilon/2, \varepsilon)$.

• *(No admitted-data rule.)* Every admitted-data rule reproduces $Q_L(\beta)$ for at most one value of β. In particular no rule of admitted data alone reproduces the named heat for two coefficient values.

• *(Energy: finite worst-case error.)* For every admitted-data rule with value r, $\sup_{\beta > 0} |r - Q_L(\beta)| = \max\{r - \varepsilon/2, \varepsilon - r\} \geq \varepsilon/4$, with equality if and only if $r = 3\varepsilon/4$; the supremum is not attained. More generally, for every finite admitted implementation and every β, $|Q_B| \leq \lambda_{max}(H_B) - \lambda_{min}(H_B)$, so the worst-case error of the rule $r = 0$ is finite.

• *(Entropy-unit bill: infinite worst-case error.)* The bill $\beta Q_L(\beta) = \beta\varepsilon/(1 + e^{-\beta\varepsilon})$, the left side of the parent's finite thermal balance (I-C-Th-v1 eq:thermal), is strictly increasing, with range $(0, \infty)$. For every admitted-data rule with value r, $\sup_{\beta > 0} |r - \beta Q_L(\beta)| = \infty$.

• *(The coefficient as supplied input.)* If a rule $R(\mathfrak{A}, \beta)$ reproduces $Q_L(\beta)$, or $\beta Q_L(\beta)$, for every $\beta > 0$, then $\beta \mapsto R(\mathfrak{A}, \beta)$ is injective; so the rule contains the coefficient as a supplied input. The ledger refuses to treat that input as derived.

Proof. (a) $SWAP_WL$ maps $proj\ 1_W \otimes \tau_L$ to $\tau_W \otimes proj\ 1_L$, so $Q_L = Tr\,[H_L(proj\ 1 - \tau_L)] = \varepsilon(1 - p) = \varepsilon e^{\beta\varepsilon}/(1 + e^{\beta\varepsilon}) = \varepsilon/(1 + e^{-\beta\varepsilon})$, as in the parent's proof of I-C-Th-v1 thm:underdetermination; the computation is complete as written. Its derivative $\varepsilon^2 e^{-\beta\varepsilon}/(1 + e^{-\beta\varepsilon})^2$ is positive, and the limits at 0 and ∞ are $\varepsilon/2$ and ε.

(b) A rule of $\mathfrak{A}$ alone takes one value r on the whole family, and by (a) $Q_L(\beta) = r$ has at most one solution.

(c) By (a), $\sup_{\beta} |r - Q_L(\beta)| = \sup_{x \in (\varepsilon/2, \varepsilon)} |r - x| = \max\{r - \varepsilon/2, \varepsilon - r\}$, which is at least the half-length $\varepsilon/4$ of the interval, with equality exactly at its midpoint; the open interval does not contain its endpoints, so the supremum is not attained. In general $Q_B = Tr\,H_B\omega_B - Tr\,H_B\tau_B$ is a difference of two numbers in $[\lambda_{min}(H_B), \lambda_{max}(H_B)]$.

(d) $\beta \mapsto \beta$ and $\beta \mapsto Q_L(\beta)$ are positive and strictly increasing, so their product is; it tends to 0 at 0 and is at least $\beta\varepsilon/2$, hence unbounded.

(e) Two values $\beta \neq \beta^{\prime}$ with $R(\mathfrak{A}, \beta) = R(\mathfrak{A}, \beta^{\prime})$ would give $Q_L(\beta) = Q_L(\beta^{\prime})$, contradicting (a); likewise for βQ_L by (d).

par *Does not imply*. The certificate is a documentary separation on a finite witness family. It does not imply a temperature of any host, a derived reservoir, a thermodynamic law, an optimum cyclic cost, or a Hawking temperature; and it does not imply that a quantum coefficient is admitted. The cone and its deficit remain inputs. par

Proposition. With the same visible channel and spectator Hamiltonians, the identity implementation on WL (also used in I-C-Th-v1 thm:underdetermination) gives $Q_L(\beta) = 0$ for every β. Hence the map $\beta \mapsto Q_L(\beta)$ is not injective for every implementation with fixed admitted channel and spectator Hamiltonians; injectivity is a property of the witness family. For every fixed finite implementation, either $\beta \mapsto Q_B(\beta)$ is constant, or no admitted-data rule reproduces it on the whole family.

Proof. The identity leaves τ_L unchanged. For the last sentence: a rule of the admitted data takes a single value on the family.

par *Does not imply*. The proposition does not imply that the energy gain is identified by any further datum; it records only that the certificate is an existence statement for a witness family. par

Version 2: the implementation separation, the balance, and the dichotomy

This section is new in version 2 (plan t258u). Everything in it is proved locally; Big01-A and VC-OB-1 are cited as source records only. Throughout, a *finite implementation* is a finite non-reservoir system M in a state ρ_M, a reservoir B with a finite Hamiltonian H_B prepared in $\tau_B(\beta) = e^{-\beta H_B}/Tr\, e^{-\beta H_B}$, and a unitary U on MB; $\omega = U(\rho_M \otimes \tau_B)U^{\dagger}$, $Q_B = Tr\,[H_B(\omega_B - \tau_B)]$, and $w(H_B) = \lambda_{max}(H_B) - \lambda_{min}(H_B)$.

Proposition. For every finite implementation and every $\beta > 0$,

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

So the balance holds for every unitary, energy conserving or not, and for every β; by itself it selects neither an implementation nor a value of β.

Proof. $\log \tau_B = -\beta H_B - \log Z$ gives $D(\omega_B\|\tau_B) = -S(\omega_B) + \beta Tr\, H_B\omega_B + \log Z$ and $S(\tau_B) = \beta Tr\, H_B\tau_B + \log Z$, so $D = \beta Q_B - S(\omega_B) + S(\tau_B)$. Unitarity gives $S(\omega_{MB}) = S(\rho_M) + S(\tau_B)$, so $I(M: B)_{\omega} = S(\omega_M) + S(\omega_B) - S(\rho_M) - S(\tau_B)$. Adding, $\Delta S_M + I + D = \beta Q_B$.

par *Does not imply*. This re-proves the identity recorded in the parent (I-C-Th-v1 thm:thermal) for local use; it is the thermal-ledger analogue of the vacuity part of Big01-A's dynamics certificate (Big01-A prop:Dyncert(a)), which is a different statement about the Einstein tensor and is not used. It does not derive a temperature or select an implementation. Check C13 corroborates it for three unitaries. par

Proposition. Fix $\beta > 0$ and the *admitted channel data* $\mathfrak{A}_{ch}$: the visible implementation and its selected channel, the spectator Hamiltonians $H_W = H_L = \varepsilon proj\ 1$, the initial state $proj\ 1_W \otimes \tau_L(\beta)$, the designation of L as reservoir, and β (but not the spectator unitary). The identity and $SWAP_{WL}$ both commute with $H_W + H_L$, leave the visible channel unchanged, and give

$$Q_L^{\mathrm{id}} = 0, \qquad Q_L^{\mathrm{SWAP}} = \frac{\varepsilon}{1 + e^{-\beta\varepsilon}} \in \left(\frac{\varepsilon}{2}, \varepsilon\right).$$

Hence no rule $\mathfrak{A}_{ch} \mapsto r$ reproduces the bill for both implementations, and the two-point minimax error is exactly $Q_L^{SWAP}/2 \in (\varepsilon/4, \varepsilon/2)$. The balance terms are $(0, 0, 0)$ for the identity and $(\Delta S_W, I, D) = (-h(p), 0, -\log p)$ for $SWAP$, $p = (1 + e^{\beta\varepsilon})^{-1}$, h the binary entropy; both satisfy Proposition .

Proof. The bills are Theorem (a) and Proposition . A rule takes one value r on both, and $\max\{|r|, |r - Q|\} \geq Q/2$ with equality at $r = Q/2$. For $SWAP$, $\omega = \tau_W \otimes proj\ 1_L$ is a product, so $I = 0$; $S(proj\ 1) = 0$ and $S(\tau_W) = h(p)$; and $D(proj\ 1\|\tau_L) = -\log p$. Indeed $-h(p) - \log p = (1 - p)\log (1 - p)/p = (1 - p)\beta\varepsilon = \beta Q_L^{SWAP}$.

par *Does not imply*. This is a documentary separation in the style of Big01-A's dynamics certificate (Big01-A

prop:Dyncert(b),(c)): the admitted channel data do not determine the bill, because the spectator dynamics is an additional input. It does not imply that either implementation is physical, and it derives no temperature. par

Proposition. On the witness family, $\beta \mapsto Q_L(\beta)$ is a bijection of $(0, \infty)$ onto $(\varepsilon/2, \varepsilon)$ with inverse $\beta = \varepsilon^{-1}\log(Q/(\varepsilon - Q))$. So supplying the bill supplies β, and conversely; for every named value β_{*} (in particular a numerical value attached to a label), a rule that outputs $Q_L(\beta_{*})$ on the family contains β_{*} as a supplied input.

Proof. Solve $Q = \varepsilon/(1 + e^{-\beta\varepsilon})$: $e^{-\beta\varepsilon} = (\varepsilon - Q)/Q$. The last sentence is Theorem (b),(e).

par *Does not imply*. The witness bill is a finite thermal balance with a supplied β; it is not a horizon temperature and implies none. Big01-A's thermal statement (Big01-A thm:Bthermal) concerns the error of a thermal replacement channel, a different quantity, and also uses a temperature only as a supplied numerical value; it is not used. The named inverse temperature stays a supplied input; no temperature is derived. par

Proposition. For every finite implementation and every $c \in \mathbb{R}$, replacing H_B by $H_B + c\,I$ leaves $\tau_B(\beta)$, ω, Q_B and every term of the balance unchanged, while the absolute reservoir energies $Tr\, H_B\tau_B$ and $Tr\, H_B\omega_B$ shift by c. Hence the absolute reservoir energy is not a function of the bill (or of any balance term), and the bill is a difference of two energies with the same subtraction.

Proof. $e^{-\beta(H_B + c)} = e^{-\beta c}e^{-\beta H_B}$, so the Gibbs state is unchanged, hence ω is unchanged. $Tr\,[(H_B + c)(\omega_B - \tau_B)] = Q_B + c(Tr\,\omega_B - Tr\,\tau_B) = Q_B$. The absolute energies shift by $cTr\,\rho = c$. Apply the fibre criterion: equal data, targets differing by c.

par *Does not imply*. The energy gain on a finite witness is not a vacuum-energy calculation, and no absolute vacuum energy is computed. The pattern is VC-OB-1's renormalization fibre (VC-OB-1 prop:VC-renorm, VC-OB-1 thm:VC-fibre, with the conclusion of VC-OB-1 thm:VC-main that the absolute value is not a function of the registered data); that sheet is a source record and is not used. Check C13 corroborates the shift invariance. par

Proposition. Fix a finite implementation (ρ_M, H_B, U) and let β range over $(0, \infty)$, with $m_{\pm}$ the supremum and infimum of $Q_B(\beta)$. Then either $\beta \mapsto Q_B(\beta)$ is constant, or no admitted-data rule (a single number r for the whole family) reproduces it. In both cases the best worst-case error of an admitted-data rule is exactly $(m_{+} - m_{-})/2$, attained by $r = (m_{+} + m_{-})/2$, and

$$0 \le \tfrac{1}{2}(m_{+} - m_{-}) \le w(H_B).$$

It is 0 iff Q_B is constant in β. On the witness family it is $\varepsilon/4$; for the identity implementation it is 0.

Proof. A single value r reproduces a non-constant function at most on a level set, not everywhere. For any r, $\sup_{\beta} |r - Q_B(\beta)| = \max\{m_{+} - r, r - m_{-}\} \ge (m_{+} - m_{-})/2$, with equality iff r is the midpoint. By Theorem (c), $|Q_B| \le w(H_B)$, so $m_{+} - m_{-} \le 2w(H_B)$. The witness values are Theorem (c) and Proposition .

par *Does not imply*. The dichotomy restates the last sentence of Proposition as a separate statement with the exact best error. It does not imply that the error is attained at some β, and it does not identify any implementation as physical. Check C13 corroborates the midpoint rule for a partial swap. par

Version 3: the complete qubit implementation fibre and the energy-origin fibre

This section is new in version 3 (plan t262u). Everything in it is proved locally. VC-OB-1, VC-OB-1-CERT-v2, Red06-G-DSS-CERT-v2 and Big01-A are cited as source records only.

Theorem. Keep the spectator data of Definition , $H_W = H_L = \varepsilon proj\ 1$, the initial state $\rho_{WL} = proj\ 1_W \otimes \tau_L(\beta)$ with $p = (1 + e^{\beta\varepsilon})^{-1}$, but let U range over all unitaries commuting with $H_W \otimes I + I \otimes H_L$, and put $Q_L(\beta, U) = Tr\, H_L(Tr_W\,(U\rho_{WL}U^{\dagger}) - \tau_L(\beta))$ and $Q_{sw}(\beta) = \varepsilon/(1 + e^{-\beta\varepsilon})$ (the swap bill of Theorem (a)).

• $Q_L(\beta, U) = s(U)\, Q_{sw}(\beta)$ with $s(U) = |\langle 01 rvert U\, |10\rangle|^2 \in [0, 1]$ (first factor W), and every $s \in [0, 1]$ is attained.

• At fixed β, with the unitary omitted, the exact range of the bill is $[0, Q_{sw}(\beta)]$ and the exact minimax absolute

error is $Q_{sw}(\beta)/2$, attained by the midpoint.

• With the swap fixed and β omitted, the minimax error is $\varepsilon/4$ (Theorem (c)). With both U and β omitted, the range is $[0, \varepsilon)$ and the minimax error is $\varepsilon/2$, attained by $r = \varepsilon/2$.

• On the fixed-swap family Q determines $\beta = \varepsilon^{-1}\log(Q/(\varepsilon - Q))$ (Proposition). On the family of all energy-conserving U it does not: for each $Q \in (0, \varepsilon)$ the set (β, s) with $sQ_{sw}(\beta) = Q$ is infinite.

• The identity has $s = 0$ and $Q \equiv 0$. Injectivity in β is a property of the specified witness, not of every energy-conserving implementation.

Proof. $H_W \otimes I + I \otimes H_L$ has eigenspaces $\mathbb{C}|00\rangle$, $\mathrm{span}\{|10\rangle, |01\rangle\}$ and $\mathbb{C}|11\rangle$ (energies $0, \varepsilon, 2\varepsilon$), and U preserves each. So $U|11\rangle = e^{i\varphi}|11\rangle$ and $U|10\rangle = a|10\rangle + b|01\rangle$ with $|a|^2 + |b|^2 = 1$. The initial state is $(1 - p)|10\rangle\langle 10| + p|11\rangle\langle 11|$, so the final excited population of L is $p + (1 - p)|b|^2$, and $Q_L = \varepsilon(1 - p)|b|^2 = |b|^2 Q_{sw}$, because $\varepsilon(1 - p) = \varepsilon e^{\beta\varepsilon}/(1 + e^{\beta\varepsilon}) = Q_{sw}$. A real rotation by angle θ in the one-excitation eigenspace gives $|b|^2 = \sin^2\theta$, every value in $[0, 1]$. (b) For a closed interval $[m_-, m_+]$ and any r, $\max(|r - m_-|, |r - m_+|) \geq (m_+ - m_-)/2$ with equality at the midpoint. (c) The swap range is $(\varepsilon/2, \varepsilon)$ as β runs over $(0, \infty)$; with s free the range is $\bigcup_{\beta}[0, Q_{sw}(\beta)] = [0, \varepsilon)$, and for an interval with endpoints $0, \varepsilon$ (open or closed at ε) the supremum of $|r - Q|$ is $\max(r, \varepsilon - r) \geq \varepsilon/2$. (d) Q_{sw} increases to ε, so every β with $Q_{sw}(\beta) > Q$ (an unbounded interval of β) gives $s = Q/Q_{sw}(\beta) \in (0, 1)$. (e) is (a) with $U = I$.

par *Does not imply*. The theorem is about one finite qubit witness with supplied β. It does not derive a temperature, a reservoir or an implementation, and it does not imply that a bill identifies β outside the fixed-swap family. Check C19 corroborates (a) on random energy-conserving unitaries and exhibits four pairs (β, s) with the same bill. par

Corollary. On the fixed-swap family, for two inverse temperatures, $\inf_r \max_i |r - Q_{sw}(\beta_i)| = 1/2|Q_{sw}(\beta_1) - Q_{sw}(\beta_2)|$. The energy bill has finite worst-case error over the whole family, while the dimensionless bill $\beta Q_{sw}(\beta) \geq \beta\varepsilon/2$ has infinite worst-case absolute error. Calling both ``coefficients" does not change either conclusion.

Proof. The two-point value is the midpoint inequality of the proof of Theorem (b). The energy range $(\varepsilon/2, \varepsilon)$ is bounded; $\beta Q_{sw}(\beta) \geq \beta\varepsilon/2$ because $Q_{sw} > \varepsilon/2$, and this is unbounded.

par *Does not imply*. This restates Theorem (c),(d) in two-point form; it does not compare with any host coefficient. par

Proposition. Fix a finite implementation and compare $H_B^{(c)} = H_B + cI$, $c \in \mathbb{R}$. The Gibbs preparation, the final state, the bill and every balance term are unchanged (Proposition); the initial and final absolute reservoir energies each increase by c. On the reduced datum that retains only these shift-invariant quantities, either absolute energy has exact two-point minimax error $|c_1 - c_2|/2$, and every fixed estimate has infinite worst-case error over $c \in \mathbb{R}$. This is not a non-identification statement for a datum that supplies the full Hamiltonian with its additive constant.

Proof. $e^{-\beta(H_B + cI)}/\mathrm{Tr}\, e^{-\beta(H_B + cI)} = e^{-\beta H_B}/\mathrm{Tr}\, e^{-\beta H_B}$. If U commutes with $H_S + H_B$ it commutes with $H_S + H_B + cI$, so the final state is unchanged; $\mathrm{Tr}[(H_B + cI)(\omega_B - \tau_B)] = \mathrm{Tr}[H_B(\omega_B - \tau_B)]$ because both states have trace one; absolute energies $\mathrm{Tr}[(H_B + cI)\tau_B]$ and $\mathrm{Tr}[(H_B + cI)\omega_B]$ increase by c. On the reduced datum the target ranges over $E_0 + c$, $c \in \mathbb{R}$; apply the midpoint inequality, and $|r - E_0 - c| \geq |c| - |r - E_0|$.

par *Does not imply*. The proposition concerns a finite reservoir Hamiltonian. It does not compute an absolute vacuum energy and does not identify a finite Hamiltonian shift with the stress-tensor counterterms of any host. par

Documentary comparisons

VC. Proposition is the exact reduced-data reading of Proposition . VC-OB-1 prop:VC-renorm and VC-OB-1 thm:VC-fibre (labels of the source record VC-OB-1 v5; VC-OB-1-CERT-v2 re-proves them as VC-OB-1-CERT-v2 prop:VCc-fibres and VC-OB-1-CERT-v2 thm:VCc-fibre) concern invariance of relative quantities under a common shift. VC-OB-1 prop:VC-renorm makes the shift by $c\,g$ admissible, and it is not the only freedom: VC-OB-1 prop:VC-renorm2 adds curvature terms (re-verified; VC-OB-1-CERT-v2 prop:v2-VC-renorm states the same). Neither identifies finite Hamiltonian shifts with all permitted counterterms or computes absolute vacuum energy. The absolute reservoir energy is not a function of the bill alone.

Big01-A. Proposition and Big01-A prop:Dyncert have the same two-account logic: equal reduced data and distinct targets exclude a common exact estimator. Their losses and omitted data differ: here the omitted datum is a spectator unitary and the separation is bounded (at most $Q_{sw}/2 < \varepsilon/2$); there the comparison futures have tt -components differing by $3(K_1^2 - K_2^2)$, with two-point radius $3/2|K_1^2 - K_2^2|$, unbounded in K. Neither derives a temperature or Einstein dynamics.

Red06. The comparison of Proposition with Red06-G-DSS-CERT-v2 thm:RC-coef is restricted to omitted-input dependence. The inverse formula identifies a sufficient numerical datum on one fixed implementation family; it does not identify the bill with a horizon temperature and does not require an implementation to contain a variable named β.

Thermal cross-reference. The finite balance of Proposition is an entropy identity, not a Bell/Choi primal–dual sandwich; its equality form in the initially product, Gibbs-reservoir, unitary setting is standard [ReebWolf]. The channel sandwiches of I-C-CERT, I-C-Ex-CERT and I-C-Ex2-CERT are comparisons, not premises of it.

Typed cross-reference. The coefficient-fibre pattern applies to the fixed-swap witness, but infinite absolute risk belongs to βQ, not to the bounded finite-reservoir energy gain Q; the local thermal proof is not a Bell/Choi dual proof.

Version 4: the radius lemma, bounded and unbounded named quantities, and the plan-t266u readings

This section is new in version 4 (plan t266u). Everything in it is proved locally from Definition and Sections –. VC-OB-1-CERT-v2, VC-OB-1, Red06-G-DSS-CERT-v3, DS-OB-1-CERT-v2, Hawk07-F-CERT-v3 and Big01-A are cited as source records only; I-C-Th-CERT-v3 is the previous version of this sheet.

Lemma. Let $A \subseteq \mathbb{R}$ be nonempty. If A is bounded, then for every $r \in \mathbb{R}$

$$\sup_{a \in A} |r - a| = \max\{r - \inf A,\ \sup A - r\} \ \geq \tfrac{1}{2}(\sup A - \inf A),$$

with equality if and only if $r = 1/2(\sup A + \inf A)$. If A is unbounded, $\sup_{a \in A} |r - a| = \infty$ for every r.

Proof. For $a \in A$, $|r - a| \leq \max\{r - \inf A, \sup A - r\}$, and taking a near $\inf A$ or near $\sup A$ shows that the supremum is this maximum. The two terms sum to $\sup A - \inf A$, so the maximum is at least half of it, with equality iff the terms are equal. If A is unbounded above (below), $a - r$ ($r - a$) is unbounded on A.

par *Does not imply*. The lemma is elementary; it is the common minimax step behind Theorem (c),(d) and Proposition , stated once. It supplies no value of any coefficient. par

Proposition. Rules are constants r, as in Theorem .

• On the coefficient family of Definition , the energy gain $Q_L(\beta)$ has range $(\varepsilon/2, \varepsilon)$; the least worst-case error over $\beta \in (0, \infty)$ is $\varepsilon/4$, attained only by $r = 3\varepsilon/4$; over $\beta \in [\beta_1, \beta_2]$ it is $1/2(Q_L(\beta_2) - Q_L(\beta_1))$.

• The bill $\beta Q_L(\beta)$ has range $(0, \infty)$; every rule has infinite worst-case error.

• For $\Delta > 0$ the function $e(\beta) = 1 - 1/(2 + 2\cosh \beta\Delta)$ is strictly increasing on $(0, \infty)$ with range $(3/4, 1)$; it is injective in β, and its least worst-case error is $1/8$, attained only by $r = 7/8$.

• For fixed $H, c, G, k_B > 0$, the functions $\varkappa \mapsto \varkappa H/(2\pi k_B)$ and $\varkappa \mapsto \pi k_B c^5/(\varkappa GH^2)$ on $(0, \infty)$ have range $(0, \infty)$; every constant rule has infinite worst-case error. So injectivity in the coefficient is shared by all four, while finiteness of the worst-case error separates (a), (c) from (b), (d).

Proof. (a) and (b): the ranges are Theorem (a),(d), and Q_L is strictly increasing, so $Q_L([\beta_1, \beta_2]) = [Q_L(\beta_1), Q_L(\beta_2)]$; apply Lemma . (c) $e'(\beta) = 2\Delta\sinh(\beta\Delta)/(2 + 2\cosh \beta\Delta)^2 > 0$ on $(0, \infty)$, $e(\beta) \to 1 - 1/4$ as $\beta \to 0^+$ and $e(\beta) \to 1$ as $\beta \to \infty$; apply Lemma . (d) The first map is linear with positive slope, the second is a positive multiple of $1/\varkappa$; both are bijections of $(0, \infty)$; apply Lemma .

par *Does not imply*. (c) and (d) are statements about displayed functions. That $e(\beta)$ is the error of a thermal replacement channel is the content of Big01-A thm:Bthermal(b), a source record, and is not used; that the maps in (d) are the named labels $T^{(\varkappa)}, S^{(\varkappa)}$ of Red06-G-DSS-CERT-v3 thm:RC-coef is a reading of that source record. No temperature, entropy or horizon is derived. Check C24 corroborates (a) and (c) on grids. par

Readings required by plan t266u

VC-OB-1-CERT-v2: the renormalization fibre. Proposition is the two-point minimax for the reservoir shift $H_B \mapsto H_B + cI$. VC-OB-1-CERT-v2 prop:v2-VC-renorm(a) does enlarge the renormalization fibre to $\{T + c_0 g + c_1^{(1)}H + c_2^{(2)}H\}$, with the tensors of VC-OB-1-CERT-v2 def:v2-H, which that definition calls ``the standard expressions for the metric variations of $\int R^2$ and $\int R_{\alpha\beta}R^{\alpha\beta}$ up to normalization". That description does not hold in the curvature convention of VC-OB-1-CERT-v2 itself (de Sitter has $R = 12K^2 > 0$ there): by check C20 (computer-assisted, exact), on $-dt^2 + e^{2t^3/3}dx^2$ both displayed tensors have nonzero divergence (the t-component of $\nabla^{\mu}\,{}^{(1)}H_{\mu\nu}$ is 2160 at $t = 1$, the value of $4R_{\nu\mu}\nabla^{\mu}R$), whereas the tensors with the two derivative terms reversed, and the ${}^{(1)}H$ of the parent VC-OB-1 prop:VC-renorm2 (whose algebraic terms have the opposite signs to the CERT display), are divergence-free on that metric. So the plan's ``enlarges the renormalization fibre by curvature counterterms" matches the parent's statement (prop:VC-renorm2, whose ${}^{(1)}H$ check C20 corroborates on that metric) and, for the CERT, describes the intended tensors, not the displayed ones. Hawk07-F/G/H-CERT-v3 record the same error for the identical display in their version 2 (Hawk07-F-CERT-v3 prop:v3-E, item E6 of Hawk07-F-CERT-v3 sec:cert-errors). Not decided here: which parts of prop:v2-VC-renorm(a)–(c) survive with corrected tensors (part (b) on Einstein regions does, since both displayed tensors vanish when $Ric = R/4g$ with R constant). VC-OB-1-CERT v3 is in preparation elsewhere and was not read. Both fibre statements concern relative quantities; neither computes absolute energy.

Red06-G-DSS-CERT-v3. Red06-G-DSS-CERT-v3 thm:RC-coef is the injectivity form for $T^{(\varkappa)}$, $S^{(\varkappa)}$ with the admitted data H, c, G, k_B of the prescribed host DSS_H (checked). The plan's ``same form" as Theorem for $Q_L(\beta)$ is qualified: injectivity is shared, but $T^{(\varkappa)}$, $S^{(\varkappa)}$ are unbounded, with infinite worst-case error (its part (b); Proposition (d)), while Q_L is bounded, with worst-case error $\varepsilon/4$. The analogue of $T^{(\varkappa)}$ on this sheet is βQ_L, not Q_L. Both are named thermal quantities of prescribed data; neither derives a temperature, and the permanent negative for a horizon temperature stays. Red06-G-DSS-CERT-v4 is delivered; thm:RC-coef and prop:RC-dyn are unchanged from v3.

Big01-A. Big01-A thm:Bthermal concerns the error of replacement by a Gibbs state, with the temperature supplied; for a qubit that error is the bounded injective function $e(\beta)$ of Proposition (c). Both sheets let the temperature enter as a supplied value; neither derives a horizon temperature. The finite balance of Proposition stays an entropy identity.

The coefficient cross-reference line. The plan's line ``the form is the same; the hosts and the named quantities differ" holds between this sheet and the de Sitter sheets (a two-qubit implementation versus DSS_H; a heat versus horizon labels). It is false inside the de Sitter group that the plan lists with it: DS-OB-1-CERT-v2 thm:DS-coef6 and Red06-G-DSS-CERT-v3 thm:RC-coef are on the same prescribed host DSS_H, and their labels are the same formulas ($T^{(q)} = qH/(2\pi k_B)$ and $S^{(q)} = \pi k_B c^5/(qGH^2)$, as the inversions in thm:DS-coef6(c) show); Big01-A is on the same host. There the correct line is ``same host and same named quantities; different admitted classes".

Typed cross-reference. The coefficient-fibre pattern applies to Q_L and to βQ_L; infinite worst-case error belongs to βQ_L only. No derived temperature.

Version 5: the renormalization fibre with corrected tensors

This section is new in version 5 (request t267u; no plan was attached). Its theorem and lemma are proved locally; VC-OB-1-CERT-v3, DS-OB-1-CERT-v3, Hawk07-F-CERT-v3 and Red06-G-DSS-CERT-v4 are cited by sha256 as source records only, and I-C-Th-CERT-v4 is the previous version of this sheet. Other streams are concurrently building Hawk07 CERT version 4, the OB CERT sheets version 4 and DSS CERT version 5; their files were not read, and any statement here about the companions refers only to the delivered versions cited by sha256.

The corrected tensors

Use signature $(-\,+\,+\,+)$ and the curvature convention of check C20 ($R^a{}_{bcd} = \partial_c \Gamma_{db}{}^a - \partial_d \Gamma_{cb}{}^a + \Gamma_{ce}{}^a \Gamma_{db}{}^e - \Gamma_{de}{}^a \Gamma_{cb}{}^e$, $R_{bd} = R^a{}_{bad}$, so de Sitter has $R = 12K^2 > 0$), which is the convention stated in VC-OB-1-CERT-v3 def:v3-E. For a C^4 metric on a four-manifold put

$$E^{(1)}_{\mu\nu} = 2RR_{\mu\nu} - \tfrac{1}{2}g_{\mu\nu}R^2 + 2g_{\mu\nu}\Box R - 2\nabla_\mu\nabla_\nu R,$$

$$E^{(2)}_{\mu\nu} = 2R_{\mu\alpha\nu\beta}R^{\alpha\beta} - \tfrac{1}{2}g_{\mu\nu}R_{\alpha\beta}R^{\alpha\beta} + \Box R_{\mu\nu} + \tfrac{1}{2}g_{\mu\nu}\Box R - \nabla_\mu\nabla_\nu R,$$

the tensors displayed in VC-OB-1-CERT-v3 def:v3-E (restated here, not imported), and let *^{(1)}H, ^{(2)}H* be the tensors displayed in VC-OB-1-CERT-v2 def:v2-H.

Theorem.

• For every *C^5* metric, *∇^{μ}E_{μν}^{(1)} = 0*.

• *^{(1)}H = E^{(1)} + 4(∇∇R − gBox R)* and *∇^{μ} ^{(1)}H_{μν} = 4R_{νλ}∇^{λ}R*. Also *^{(2)}H_{μν} = −E_{μν}^{(2)} + 4R_{μλ}R^{λ}_{ν} − g_{μν}R_{αβ}R^{αβ}*.

• On every open set where *Ric = R/4g*: *R* is constant, and *E^{(1)} = E^{(2)} = ^{(1)}H = ^{(2)}H = 0*.

Proof. We use *∇^{μ}R_{μν} = 1/2∇_{ν}R* and, for a scalar *f*, *Box ∇_{ν}f = ∇_{ν}Box f + R_{νλ}∇^{λ}f*, which follows from *[∇_{μ}, ∇_{ν}]V^{ρ} = R^{ρ}_{σμν}V^{σ}* in this convention. (a) *∇^{μ}(2RR_{μν}) = 2R_{νμ}∇^{μ}R + R∇_{ν}R*, *∇^{μ}(−1/2g_{μν}R^2) = −R∇_{ν}R*, *∇^{μ}(2g_{μν}Box R) = 2∇_{ν}Box R* and *∇^{μ}(−2∇_{μ}∇_{ν}R) = −2Box ∇_{ν}R = −2∇_{ν}Box R − 2R_{νλ}∇^{λ}R*. The sum is *0*. (b) The first identity is read off from the two displays, whose algebraic terms agree and whose derivative terms have opposite signs. Its divergence is *4(Box ∇_{ν}R − ∇_{ν}Box R) = 4R_{νλ}∇^{λ}R* by (a). For the second, the commutator gives *[∇_{α}, ∇_{ν}]R^{α}_{μ} = R_{λν}R^{λ}_{μ} − R_{μανβ}R^{αβ}*, hence *∇_{α}∇_{ν}R^{α}_{μ} = 1/2∇_{ν}∇_{μ}R + R_{λν}R^{λ}_{μ} − R_{μανβ}R^{αβ}*; substituting this into the display of *^{(2)}H* (which contains *2∇_{α}∇_{ν}R^{α}_{μ} − Box R_{μν} − 1/2g_{μν}Box R − 1/2g_{μν}R_{αβ}R^{αβ} + 2R_{μ}^{α}R_{αν}*) and comparing with *E^{(2)}* gives the identity. (c) The contracted Bianchi identity gives *0 = ∇^{μ}(R_{μν} − 1/2Rg_{μν}) = ∇_{ν}(R/4 − R/2)*, so *R* is constant (dimension *4*), and *∇Ric = 0*. All derivative terms vanish. Then *E^{(1)} = 2RR/4g − 1/2gR^2 = 0*; with *R_{μανβ}g^{αβ} = R_{μν}*, *E^{(2)} = 2R/4 · R/4g − 1/2g(R^2)/4 = 0*; and by (b) *^{(1)}H = 0* and *^{(2)}H = 4(R^2)/16g − g(R^2)/4 = 0*.

par *Does not imply.* Part (a) is the conservation of the *R^2* direction; the conservation of *E^{(2)}* is *not* proved here (VC-OB-1-CERT-v3 lem:v3-Ediv(b) also labels it partial). Check C25 (computer-assisted, exact sympy) finds *∇ · E^{(1)} = ∇ · E^{(2)} = 0* and the identities of (b) on two test metrics (a spatially flat FLRW metric and a Bianchi-I metric); that corroborates, it does not prove, the conservation of *E^{(2)}*. No absolute energy is computed. par

Lemma. Let *F ⊆ F^{'}* be sets of admitted objects, *δ* a datum and *τ* a real target on *F^{'}*. If *τ* is not a function of *δ* on *F*, it is not one on *F^{'}*. For every rule *r* of the datum, *sup_{F^{'}} |r(δ) − τ| ≥ sup_F |r(δ) − τ|*; so every lower bound on the minimax error over *F* holds over *F^{'}*, and an infinite minimax error over *F* stays infinite.

Proof. Two objects of *F* with the same datum and different targets lie in *F^{'}*; a supremum over a larger set is not smaller.

par *Does not imply.* The lemma transports negative statements only. An exact finite minimax value over *F* may increase over *F^{'}*, and nothing about conservation or admissibility of the new objects follows. par

Proposition. Let *T* be a local, covariant, conserved stress and *F_E = {T + c_0g + c_1E^{(1)} + c_2E^{(2)}}*, *F_0 = {T + c_0g} ⊆ F_E*. For the three parts of VC-OB-1-CERT-v2 prop:v2-VC-renorm:

• *Part (a) survives as far as it is negative.* Every member with *c_2 = 0* is local, covariant and conserved (Theorem (a)). The non-function statement and every lower bound on minimax error proved on *F_0* hold on *F_E* by Lemma , using only the subfamily *F_0*. Admissibility of members with *c_2 ≠ 0* is partial (conservation of *E^{(2)}* not proved here).

• *Part (b) survives.* Null contractions are unchanged by *c_0* everywhere, and by *c_1*, *c_2* on every open set where *Ric = R/4g* (Theorem (c)); the hypothesis ``*R* constant'' there is automatic in dimension four.

• *Part (c) survives qualitatively, with different numbers.* On *− dt^2 + e^{2t^3/3} dx^2* with *k = ∂_t + e^{−t^3/3}∂_x* at *t = 1*, *E^{(1)}(k, k) = −360* and *E^{(2)}(k, k) = −120* (check C25, computer-assisted, exact); the number *−24* belongs to the displayed *^{(1)}H*. For constant rate *f = Kt* both null contractions vanish (Theorem (c), since *− dt^2 + e^2Kt dx^2* has *Ric = R/4g*).

Proof. (a) *g* and *E^{(1)}* are local, covariant and divergence-free, so *T + c_0g + c_1E^{(1)}* is conserved; the rest is Lemma . (b) *g(k, k) = 0* and Theorem (c). (c) The two values are those of check C25; that *− dt^2 + e^2Kt dx^2* is Einstein is the de Sitter (or, for *K = 0*, Minkowski) curvature, also recorded by C20 and C25 (*R = 12K^2*, *E^{(1)} = E^{(2)} = 0*).

par *Does not imply*. The proposition decides which parts of the version-2 statement survive; it does not make the vacuum term a function of any datum, does not compute absolute vacuum energy, and does not decide whether exact finite minimax values recorded in VC-OB-1-CERT change on the enlarged fibre. The numerical values in (c) rest on the computer-assisted check C25, not on a hand computation. par

Documentary readings of newly delivered companions

VC-OB-1-CERT-v3. (sha256 502f6e5ebcc9bbe8906026bc539b513afe9cff04efd1bd75aadc7141d868842d.) VC-OB-1-CERT-v3 prop:v3-VC-H records the same corrections: *∇^{μ} ^{(1)}H_{μν} = 4R_{νμ}∇^{μ}R*, *^{(1)}H = E^{(1)} + 4(∇∇R − gBox R)*, the parent's *^{(1)}H* equal to *−E^{(1)}*, the values *−360* and *−120*, and the version-2 proposition true as stated only for the displayed tensors. VC-OB-1-CERT-v3 prop:v3-VC-renorm0 is Theorem (c), and VC-OB-1-CERT-v3 lem:v3-Ediv states (a) with (b) partial. These agree with Theorem and Proposition , which were proved and checked here independently (C25 is this sheet's own check; nothing is transferred). The version-2 parent comparison V3E.1 of this sheet's version 4 is confirmed. VC-OB-1-CERT-v3 prop:v3-VC-late, VC-OB-1-CERT-v3 prop:v3-VC-alltime and VC-OB-1-CERT-v3 cor:v3-VC-hawk concern the comparison family and are not used.

DS-OB-1-CERT-v3. (sha256 07b600a11b5ec1661b651f74d473d270aa6e114463da94f051c630dd7b1758ea.) DS-OB-1-CERT-v3 prop:v3-DS-renorm: a state-independent tensor added to every state's stress leaves state differences unchanged and moves null contractions by *C(k, k)*; at the de Sitter host *g_H* the curvature-squared directions vanish, so the enlarged fibre equals *{T + c_0g}* there. This is Theorem (c) at one Einstein metric. DS-OB-1-CERT-v3 prop:v3-DS-orbit(b) shows that the product *TS = c^5/(2GH)* of two unadmitted labels is a function of the admitted data with error *0*: a combination of named targets can be determined even when each is not. Its counterpart here is the opposite case: *Q_L* and *βQ_L* each determine *β* (Proposition), so neither combination is free of the omitted parameter. Hosts are not identified.

Red06-G-DSS-CERT-v4. (sha256 574d8abfdcd620476e8054092bce4323652afd03740ceb917a165798bc653ebc.) doc:RC-thermal reads I-C-Th-CERT-v2 thm:th-cert as an injectivity certificate whose named target *Q_L* has range *(ε/2, ε)* and finite worst-case error, and whose *βQ_L* has infinite worst-case error, against the unbounded *T^{(varkappa)}*, *S^{(varkappa)}*. That is an accurate reading of this sheet (re-checked against Theorem and Proposition). It is a source record; no temperature is derived on either side.

Hawk07-F-CERT-v3. (sha256 2280220e1bddd21e787032d88903764932f23d06bc5100722b08891a9c536dd6.) Hawk07-F-CERT-v3 cor:v3-fibre gives the same values *−360*, *−120* for the identical metric, null vector and tensors, and *−24*, *−104* for the version-2 display. Its thm:v3-parallel (null contractions along a parallel null field are fibre-invariant) is a further surviving case not used here.

Version 6: conservation of E^{(2)}, the conserved fibre, and the companion readings

This section is new in version 6 (request t268u; no plan was attached). Everything in it is proved locally from the earlier sections of this sheet, including Sections and ; computer-assisted checks are labelled as such, and standard facts of real analysis and of linear algebra are named where they are used. The newly delivered companions (DS-, VC- and PG-OB-1-CERT-v4 and v5, Hawk07-*-CERT-v4 and v5, and the DSS-CERT-v5 and v6 sheets) are cited by sha256 as source records only, never as premises; I-C-Th-CERT-v5 is the previous version of this sheet. The companion files were verified before use against MANIFEST-CertPlan-S2v4-OB.sha256 and MANIFEST-CertPlan-S2v4-Hawk07.sha256, and, for the second wave read in this version, MANIFEST-CertPlan-S2v5-OB.sha256 and MANIFEST-CertPlan-S2v5-Hawk07.sha256 (in CertPlan/deliver), and MANIFEST-DSS-CERT-v5.sha256 and MANIFEST-DSS-CERT-v6.sha256 (in DSS/deliver); every listed hash matched.

Conservation of E^{(2)}

Conventions and tensors as in Section : *[∇_a, ∇_b]V^c = R^c_dabV^d*, hence *[∇_a, ∇_b]ω_c = −R^d_cabω_d* on covectors, *R_bd = R^a_bad*, and *|Ric|^2 = R_{αβ}R^{αβ}*.

Theorem. For every *C^5* metric of any signature on a manifold of any dimension *n ≥ 2*, *∇^{μ}E_{μν}^{(2)} = 0*.

Proof. Three identities are used. (i) The contracted second Bianchi identity *∇^aR_abcd = ∇_cR_bd − ∇_dR_bc* (contract *∇_aR_ebcd + ∇_cR_ebda + ∇_dR_ebac = 0* with *g^ae*, using *R^a_bad = R_bd*), and its trace *∇^aR_ab = 1/2∇_bR*. (ii) For a scalar *f*, *Box ∇_{ν}f = ∇_{ν}Box f + R_{νλ}∇^{λ}f* (Section). (iii) The commutator on covariant tensors, applied to *∇_{λ}R_{μν}* and to *R_{μν}*.

Step 1: ∇^{μ}Box R_{μν}. By (iii), *g^{μa}g^{λb}[∇_a, ∇_b]∇_{λ}R_{μν}* consists of three contractions. The two that act on the indices *λ* and *μ* give *−R^{ρμ}∇_{ρ}R_{μν} + R^{ρλ}∇_{λ}R_{ρν} = 0*; the third gives *−R_{ρν}^{μλ}∇_{λ}R_{μ}^{ρ}*. Hence

$$\nabla^{\mu}\mathrm{Box}\,R_{\mu\nu} = \nabla^{\lambda}(\nabla^{\mu}\nabla_{\lambda}R_{\mu\nu}) - R_{\rho\nu}{}^{\mu\lambda}\nabla_{\lambda}R_{\mu}{}^{\rho}.$$

Again by (iii) and (i), *∇^{μ}∇_{λ}R_{μν} = 1/2∇_{λ}∇_{ν}R + R^{ρ}_{λ}R_{ρν} − R_{ρνμλ}R^{μρ}*. Taking *∇^{λ}* and using (i) in the form *∇^{λ}R_{ρνμλ} = ∇_{ν}R_{μρ} − ∇_{ρ}R_{μν}*,

$$\nabla^{\lambda}\nabla^{\mu}\nabla_{\lambda}R_{\mu\nu} = \tfrac{1}{2}\mathrm{Box}\,\nabla_{\nu}R + \tfrac{1}{2}R_{\nu}{}^{\rho}\nabla_{\rho}R + 2R^{\lambda\rho}\nabla_{\lambda}R_{\rho\nu} - \tfrac{1}{2}\nabla_{\nu}|\mathrm{Ric}|^2 - R_{\rho\nu\mu\lambda}\nabla^{\lambda}R^{\mu\rho}.$$

The last term equals the commutator term above, so, with *R_{ρνμλ} = R_{λμνρ}*,

$$\nabla^{\mu}\mathrm{Box}\,R_{\mu\nu} = \tfrac{1}{2}\mathrm{Box}\,\nabla_{\nu}R + \tfrac{1}{2}R_{\nu}{}^{\rho}\nabla_{\rho}R + 2R^{\lambda\rho}\nabla_{\lambda}R_{\rho\nu} - \tfrac{1}{2}\nabla_{\nu}|\mathrm{Ric}|^2 - 2R_{\lambda\mu\nu\rho}\nabla^{\lambda}R^{\mu\rho}.$$

Step 2: the other terms. By (i), *∇^{μ}(2R_{μανβ}R^{αβ}) = 2(∇_{ν}R_{αβ} − ∇_{β}R_{αν})R^{αβ} + 2R_{μανβ}∇^{μ}R^{αβ} = ∇_{ν}|Ric|^2 − 2R^{αβ}∇_{β}R_{αν} + 2R_{μανβ}∇^{μ}R^{αβ}*. Also *∇^{μ}(−1/2g_{μν}|Ric|^2) = −1/2∇_{ν}|Ric|^2*, *∇^{μ}(1/2g_{μν}Box R) = 1/2∇_{ν}Box R*, and by (ii) *∇^{μ}(−∇_{μ}∇_{ν}R) = −∇_{ν}Box R − R_{νλ}∇^{λ}R*.

Step 3: the sum. The *|Ric|^2* terms give *1 − 1/2 − 1/2 = 0*. The terms *∓2R^{αβ}∇_{β}R_{αν}* cancel (rename and use the symmetry of *R^{αβ}*). The Riemann terms *2R_{μανβ}∇^{μ}R^{αβ} − 2R_{λμνρ}∇^{λ}R^{μρ}* cancel. What remains is *1/2Box ∇_{ν}R − 1/2∇_{ν}Box R + 1/2R_{ν}^{ρ}∇_{ρ}R − R_{νλ}∇^{λ}R*, which is *0* by (ii).

par *Does not imply.* The theorem is a local identity of differential geometry, proved by hand here; it closes the item left partial in version 5. It concerns a state-independent curvature tensor and computes no vacuum energy. Check C35 (computer-assisted, exact sympy) corroborates the result and the identity of Step 1 at a point of two non-diagonal polynomial metrics; check C25 (version 5) found *∇ · E^{(2)} = 0* on two diagonal metrics. par

Corollary. Let *T* be a local, covariant, conserved stress. For all *c_0, c_1, c_2 ∈ ℝ*, *T + c_0g + c_1E^{(1)} + c_2E^{(2)}* is local, covariant and conserved. So every member of *F_E* is admissible in the sense of Proposition , and the proviso ``admissibility of members with *c_2 ≠ 0* is partial" of its part (a) is removed.

Proof. Theorem (a), Theorem , *∇g = 0* and linearity of the divergence.

par *Does not imply.* Conservation makes the members admissible; it does not make the vacuum term a function of any datum (Lemma still transports only negative statements), and it does not decide whether exact finite minimax values recorded in VC-OB-1-CERT change on the enlarged fibre. par

Proposition. Let *g = η^2(− dη^2 + dx^2 + dy^2 + dz^2)* on *η > 0*.

• *R = 0*, so *E^{(1)} = 0*; and *Ric ≠ 0*, so *g* is not Einstein.

• *(Computer-assisted.) E^{(2)} = 0*.

• Hence *T + c_0g + c_1E^{(1)} + c_2E^{(2)} = T + c_0g* on this metric, in every component, not only in null contractions: the sufficient condition of Proposition (b) (Einstein regions) is not necessary for the curvature-squared directions to drop out.

Proof. (a) For *g = a(η)^2(− dη^2 + dx^2)* in this convention *R = 6a^{''}/a^3* (for *a = −1/(Kη)* this gives the de Sitter value *12K^2* of Section); with *a = η*, *R = 0*, and every term of *E^{(1)}* contains *R*. An Einstein metric with *R = 0* in dimension four is Ricci-flat, while here *R_{ηη} = 3/η^2* in this convention (check C35 also records *Ric ≠ 0*). (b) Check C35 computes all components of *E^{(2)}* in exact arithmetic. (c) is (a) and (b).

par *Does not imply*. Part (b) rests on a computer-assisted symbolic computation, not on a hand proof, so the proposition is labelled *partial (computer-assisted)* for (b) and (c). A structural explanation through conformal flatness (the trace-free combination *E^{(2)} − 1/3E^{(1)}* is, by a standard argument using the Gauss–Bonnet variation, proportional to the Bach tensor) is not proved here. The metric is the spatially flat radiation model; nothing is said about its physical stress or temperature. par

The two readings of the version-2 displays

Let *^{(1)}H[·], ^{(2)}H[·]* denote the display formulas of VC-OB-1-CERT-v2 def:v2-H as functions of the curvature tensor that is substituted into them, with g and ∇ fixed:

$$ {}^{(1)}H[\mathscr{R}] = 2\nabla\nabla\mathscr{R} - 2g\mathrm{Box}\,\mathscr{R} - \tfrac{1}{2}g\mathscr{R}^2 + 2\mathscr{R}\,\mathscr{R}_{\mu\nu}, $$

$$ {}^{(2)}H[\mathscr{R}] = 2\nabla_\alpha\nabla_\nu\mathscr{R}^\alpha{}_\mu - \mathrm{Box}\,\mathscr{R}_{\mu\nu} - \tfrac{1}{2}g\mathrm{Box}\,\mathscr{R} - \tfrac{1}{2}g\mathscr{R}_{\alpha\beta}\mathscr{R}^{\alpha\beta} + 2\mathscr{R}_\mu{}^\alpha\mathscr{R}_{\alpha\nu} $$

(scalar, Ricci and Riemann parts of $\mathscr{R}$ written with the same letter). This is the form used in the proof of Theorem (b). Put *R^{'}^a_bcd = −R^a_bcd*, the opposite curvature sign, so *R_bd^{'} = −R_bd*, *R^{'} = −R* and *[∇_c, ∇_d]V^a = −R^{'}^a_bcdV^b*.

Proposition. For every *C^4* metric on a four-manifold, in the convention of Section :

• *(This convention; Theorem (b).) ^{(1)}H[R] = E^{(1)} + 4(∇∇R − gBox R)* and *^{(2)}H[R] = −E^{(2)} + 4 Ric · Ric − g|Ric|^2*.

• *(Opposite sign.) ^{(1)}H[R^{'}] = E^{(1)}* and *^{(2)}H[R^{'}] = E^{(2)}*.

• The two readings differ by *^{(1)}H[R] − ^{(1)}H[R^{'}] = 4(∇∇R − gBox R)* and *^{(2)}H[R] − ^{(2)}H[R^{'}] = −2E^{(2)} + 4 Ric · Ric − g|Ric|^2*; both differences vanish on every open set where *Ric = R/4g*.

Proof. (a) is Theorem (b). (b) Substituting *R^{'} = −R, R_{μν}^{'} = −R_{μν}* into the first display gives *−2∇∇R + 2gBox R − 1/2gR^2 + 2RR_{μν} = E^{(1)}*, since the quadratic terms are even and the linear ones change sign. In the second display the linear terms change sign and the quadratic terms do not: *^{(2)}H[R^{'}] = −2∇_{α}∇_{ν}R^{α}_{μ} + Box R_{μν} + 1/2gBox R − 1/2g|Ric|^2 + 2R_{μ}^{α}R_{αν}*. The derivatives act on the same tensor field in both readings; with the commutator of this convention (proof of Theorem (b)), *∇_{α}∇_{ν}R^{α}_{μ} = 1/2∇_{ν}∇_{μ}R + R_{λν}R^{λ}_{μ} − R_{μανβ}R^{αβ}*. Substituting gives *2R_{μανβ}R^{αβ} − 1/2g|Ric|^2 + Box R_{μν} + 1/2gBox R − ∇_{μ}∇_{ν}R = E^{(2)}*. (c) Subtract (b) from (a). On such a set R is constant and *∇Ric = 0* (Theorem (c)), *E^{(2)} = 0*, and *4(R^2)/16g − (R^2)/4g = 0*.

par *Does not imply*. This settles, by hand, that VC-OB-1-CERT-v4 cor:v4-Hnorm(c) and Theorem (b) are statements about the same displays in opposite curvature-sign conventions, and that both are correct; it agrees with VC-OB-1-CERT-v5 lem:v5-display, read as a source record only. Check C35 (computer-assisted, exact) corroborates (a) and (b) for *^{(2)}H* at a point of two non-diagonal metrics. No normalization of a physical stress is chosen here. par

Documentary readings of newly delivered companions

VC-OB-1-CERT-v4. (sha256 f9802da66896159503132b736164016c1d06d2a6530bbbc06cb4ad3af0256387.) VC-OB-1-CERT-v4 thm:v4-E2div states Theorem (for *C^5* metrics of any signature and dimension), and VC-OB-1-CERT-v4 cor:v4-VC-fibre states Corollary ; both were proved there and here independently, and nothing is transferred. VC-OB-1-CERT-v4 cor:v4-Hnorm reads the parents' normalizations (*$\mathscr{H}$^{(i)} = −2E^{(i)}* in the Hawk07-F parent, *^{(i)}H = −E^{(i)}* in VC-OB-1) and notes that the variational tensors do not depend on the curvature-sign convention; this sheet uses only the displays restated in Section . Its reading of I-C-Th-CERT-v4 (the two-point form of lem:v4-radius as its own minimax step; the non-conservation found by check C20) is accurate.

Hawk07-F-CERT-v4. (sha256 3b4eef32040e7f3aad9766523b6c5deff83c9679fcd5924d3b93f5b110221e63.) Hawk07-F-CERT-v4 thm:v4-nullchar(c),(d): null contractions are the same on the whole fibre if and only if *R Ric_{∘} = (∇∇R)_{∘}* and *E^{(2)} − 1/3E^{(1)} = 0*, and these hold on the radiation metric, which is not Einstein. Proposition is consistent with (d) and records the stronger componentwise vanishing *E^{(1)} = E^{(2)} = 0* on that metric (computer-assisted for *E^{(2)}*), obtained here independently. Hawk07-F-CERT-v4 prop:v4-Evar (the

tensors are the metric variations) is not used.

DS-OB-1-CERT-v4. (sha256 0b5b86f87f91503ba9e96cf221b2ef96a4b4e96e3f27489336eb2b89848463c6.) It reads I-C-Th-CERT-v4 lem:v4-radius and I-C-Th-CERT-v4 prop:v4-types(d) as the radius lemma and the statement that *varkappa ↦ varkappa H/(2πk_B)* and *varkappa ↦ πk_Bc^5/(varkappa GH^2)* have range *(0, ∞)* and infinite worst-case error, while *Q_L* and *e(β)* are bounded; that is accurate (re-checked). Its prop:v4-DS-window(b) (a declared window would give finite least errors attained at midpoints) is the bounded case of the radius lemma in another setting; no window is declared here.

Red06-G-DSS-CERT-v5 and V-DST-DSS-CERT-v5. (sha256 e4a1b02552c138b8f9f009f2e71e391825ad0014f717b43f96883c445605213a, 4133961f566c059c22054b5922423d1ff94cb0d1c888ca353a7c143bba1541be.) Red06-G-DSS-CERT-v5 doc:RC-icrow5 qualifies readings of prop:RC-dyn by the version-4 erratum on *φ(0) = 0*; that bears on a sentence of version 4 of this sheet and is recorded in Section (E6.1). V-DST-DSS-CERT-v5 prop:VDC-E1 computes the first variation of the same *E^{(1)}* at the de Sitter host; it is not used.

Documentary readings of the second wave of companions

The following files were delivered during the preparation of this version and verified against their manifests (Section , opening paragraph). They are source records only.

VC-OB-1-CERT-v5 and DS-OB-1-CERT-v5. (sha256 d3a93a3afb0e8803d18f230ce824f78c19253f6a4bc841f8ceef763ce14f7cac, a0805f8eb081a250f78e8074b9de5986ccd23106749df9e0fe5fac2f71e157f9.) VC-OB-1-CERT-v5 lem:v5-display (identical in DS-OB-1-CERT-v5 lem:v5-display) reconciles VC-OB-1-CERT-v4 cor:v4-Hnorm(c) with I-C-Th-CERT-v5 thm:v5-E(b): the same version-2 displays read in opposite curvature-sign conventions, both readings correct. This was verified independently here (Proposition , by hand, with check C35) and agrees. VC-OB-1-CERT-v5 prop:v5-einstein-n (*Ric = R/ng* in dimension *n ≥ 3* gives *E^{(1)} = (4 − n)/(2n)R^2g*, *E^{(2)} = (4 − n)/(2n^2)R^2g*, *G = −(n − 2)/(2n)Rg*) was re-checked by hand: *2RR/ng − 1/2R^2g*, *2R/n · R/ng − 1/2(R^2)/ng* and *R/ng − R/2g*; its case *n = 4* is Theorem (c). VC-OB-1-CERT-v5 thm:v5-vac (on locally de Sitter regions the coefficients *c_1*, *c_2* do not act and the vacuum term is not a function of the metric) has the shape of Proposition (b) with Lemma ; nothing is transferred. Their readings of I-C-Th-CERT-v5 thm:v5-E, I-C-Th-CERT-v5 prop:v5-survive (including the values *−360*, *−120* and the partial admissibility for *c_2 ≠ 0*) and I-C-Th-CERT-v5 lem:v5-mono are accurate for version 5; the partial item is closed here by Corollary .

Hawk07-F-CERT-v5 and Hawk07-H-CERT-v5. (sha256 2cfa6282f30e25ac57188298f2e16d3b05a66fff4440204e6f11acce352f5bc3, 74a70015a03906e76cac8fde88a082da9789ea6e863d987be1dbba67f08bb5dd.) Hawk07-F-CERT-v5 thm:v5-frw(a),(c) states that on every spatially flat FLRW metric the trace-free tensor *B = E^{(2)} − 1/3E^{(1)}* vanishes identically and that *a = αη + β* gives the radiation metric; Hawk07-F-CERT-v5 lem:v5-scalarflat states that *E^{(1)} ≡ 0* where *R ≡ 0*. Together they assert *E^{(2)} = 0* on the radiation metric, which is Proposition (b), consistent with check C35; they are not used to remove the computer-assisted label of its part (b), which stays *partial*. Their reading of I-C-Th-CERT-v5 thm:v5-E(c) (vanishing on Einstein regions) is accurate. The Hawk07-H file carries the same version-5 labels for its own host and is read in the same way.

Red06-G-DSS-CERT-v6 and V-DST-DSS-CERT-v6. (sha256 c3f04faab2c76fb661054f2c1393bd71f484a1bfdfeeace52e5c612a34fc4599, 710c656210aab6dd708cd9f830ab7bf59df592f0887ab168b1e7fa7be2df95f9.) Red06-G-DSS-CERT-v6 doc:RC-v6read reads I-C-Th-CERT-v5 thm:v5-E(c) (*R* constant and *E^{(1)}*, *E^{(2)}* and both displays vanish where *Ric = R/4g*) and this sheet's version-5 reading of Red06-G-DSS-CERT-v4 doc:RC-thermal; both readings are accurate. V-DST-DSS-CERT-v6 doc:VDC-v6read reads I-C-Th-CERT-v5 thm:v5-E(a) as the conservation of *E^{(1)}*; accurate. Their new items (Red06-G-DSS-CERT-v6 prop:RC-geod, V-DST-DSS-CERT-v6 prop:VDC-even) are not used.

PG-OB-1-CERT-v5, Hawk07-A-CERT-v5 and En08-ST-DSS-CERT-v6. (sha256 c96ea4631de51c635521ca42fd24337728591676ee9019a24f3ad9fcdcdeb8a2, 9db43c8772a84fcf2fcf8d3674b86781ab407b93de05d370740e89f3f00b7add,

7d821d99ced3a9d265d5437f5c1466d8f524a09884730d13662278c31b1da086.) They concern finite channels and cite I-C-CERT-v5 and I-C-Ex-CERT-v5, not this sheet. None of the second-wave files records an error in version 5 of this sheet, and none was found in their readings.

Verification of plan t256u against the sheets (version 1, retained)

toprule Plan statement Finding Status

midrule Thermal coefficient ↦ designated-reservoir energy gain injective, for fixed admitted channel and spectator Hamiltonians True on the SWAP witness family (Theorem (a)); false for the identity implementation with the same data (Proposition). The parent varied the implementation, not β. corrected (scope)

No admitted-data rule reproduces the named heat for two coefficient values Theorem (b). proved

Infinite worst-case error (generic certificate text) False for the energy gain (exact minimax $\varepsilon/4$; bounded by the spectral width); true for βQ_L (Theorem (c),(d)). corrected

No temperature derived; no quantum coefficient admitted; cone and deficit stay inputs Consistent with the parent's standing conclusion (I-C-Th-v1 thm:release and the scope box after it); repeated here. confirmed

bottomrule

Plan corrections of version 1 (retained)

• ``On that family every such rule has infinite worst-case error'' is false for the designated-reservoir energy gain: on the witness family the best constant rule $3\varepsilon/4$ has worst-case error exactly $\varepsilon/4$, and on every finite admitted implementation the energy gain is bounded by the spectral width of H_B. The statement is true for the entropy-unit bill βQ_L.

• ``Maps thermal coefficient → designated-reservoir energy gain injective'' holds on the witness family, not for every implementation with the same admitted channel and spectator Hamiltonians (the identity implementation gives $Q_L \equiv 0$).

• The plan does not name the thermal coefficient; this sheet takes it to be β (equivalently k_B at a declared T), item (3) of I-C-Th-v1 spec:package.

• (Amendment t257u) The original ``new version of the existing sheet'' is superseded: this is a new standalone sheet, and I-C-Th is not given a new version.

Verification of plan t258u against the sources (version 2, retained)

Every label named by plan t258u was searched in the read-only copies (automated log plan_label_audit.json of this run). For this sheet: toprule Plan statement Finding Status

midrule Dynamics-certificate separation for the implementation; vacuity form of Big01-A prop:Dyncert The label exists (Einstein-tensor vacuity and a two-future separation). The thermal analogues are Propositions and . The separation needs β fixed and the spectator unitary removed from the admitted data, since version 1 counted the swap as admitted. proved; PC4.5

Comparison with Big01-A thm:Bthermal The label exists, but it concerns the error of a thermal replacement channel, not a heat bill; the comparison is documentary (Proposition). proved; PC4.6

VC-OB-1 reading: VC-OB-1 prop:VC-renorm as pattern The labels VC-OB-1 thm:VC-fibre, VC-OB-1 prop:VC-renorm, VC-OB-1 thm:VC-main exist. The plan's gloss ``stresses defined only up to a multiple of g'' is too strong: the proposition shows freedom at least by cg, and the same sheet adds curvature terms in its version 2 (VC-OB-1 prop:VC-renorm2). Proposition . proved; PC4.7

Scope dichotomy already the last sentence of prop:th-scope; spectral-width bound in thm:th-cert(c) Both confirmed in version 1. Now a separate statement with the exact best error $(m_{+} - m_{-})/2 \le w(H_B)$ (Proposition). confirmed; proved

bottomrule

Plan corrections of version 2 (retained)

• ``Visible channel and spectator Hamiltonians fixed, yet identity and SWAP give different bills; no rule from admitted channel data to the bill is correct on that pair'': true at each fixed β, provided the spectator unitary is not among the admitted data (in version 1's Definition it was). Proposition states it with that admitted set.

• ``Comparison with thm:Bthermal'': that theorem is about the half-diamond error of a thermal replacement channel, not about a heat bill. The comparison is recorded as documentary only; the shared point is that a temperature enters as a supplied value.

• ``prop:VC-renorm (stresses defined only up to a multiple of g)'': the proposition proves invariance of differences under the shift by cg; it does not prove that the freedom is *only* that shift, and VC-OB-1 adds curvature counterterms (VC-OB-1 prop:VC-renorm2).

Verification of plan t262u against the sources (version 3, retained)

Every label named by plan t262u was searched in the delivered read-only files, pinned by sha256 (automated log plan_label_audit.json of this run). Findings for this sheet: toprule Plan statement Finding Status

midrule Exact heat range over all energy-conserving unitaries True; proved (Theorem). The plan's ``$\varepsilon/4$ as in the supplied witness certificate'' is Theorem (c). proved

Coefficient comparison keeps loss and data map True (Corollary). proved

Energy-origin fibre True (Proposition); it extends Proposition . proved

VC-OB-1-CERT prop:VC-renorm, thm:VC-fibre Both labels are in the source record VC-OB-1 (v5), not in VC-OB-1-CERT v1 or v2, whose analogues are prop:VCc-fibres, thm:VCc-fibre, prop:v2-VC-renorm. The $c\,g$ shift is admissible and is not the only freedom (curvature terms of prop:VC-renorm2); re-verified. label corrected; PC4.8

Big01-A prop:Dyncert: unbounded two-point radii Confirmed: radius $3/2|K_1^2 - K_2^2|$ in the tt-component, unbounded over K. confirmed

Red06-G-DSS-CERT-v2 thm:RC-coef Exists (v2 and v3); injectivity form for $T^{(\varkappa)}, S^{(\varkappa)}$ on the prescribed DSS_H. confirmed

Thermal balance is not a Bell/Choi sandwich Confirmed; versions 1 and 2 of this sheet do not claim otherwise. confirmed

bottomrule

Plan corrections of version 3 (retained)

• The plan cites prop:VC-renorm and thm:VC-fibre as labels of VC-OB-1-CERT. They are labels of VC-OB-1 (v5); VC-OB-1-CERT re-proves the fibre statements under prop:VCc-fibres, thm:VCc-fibre and enlarges the renormalization fibre in prop:v2-VC-renorm.

• The plan's ``thermal cross-reference correction'' corrects nothing in this sheet: no version of I-C-Th-CERT presents the balance as a sandwich. It is kept as a documentary statement.

Errors found in version 2. None.

Verification of plan t266u against the sources

Every label named by plan t266u (sha256 39aea6f1117318f9517712567fc87db46dd188176498fd71ff637076175f0621) was searched in the delivered read-only files, pinned by sha256 (automated log plan_label_audit.json of this run: Big01-A v5; v1 and v2 of DS-OB-1-CERT, VC-OB-1-CERT and PG-OB-1-CERT; v2 and v3 of Hawk07-A/B/C/F/G/H-CERT; v2, v3 and v4 of the three DSS CERT sheets; v3 of the five sheets of this family; the OpenAI catalogue). The OB sheets' version 3, in preparation elsewhere, was not read. Findings for this sheet: toprule Plan statement Finding Status

midrule Big01-A labels, including thm:Bthermal All present in Big01-A v5. thm:Bthermal is the error of a Gibbs replacement channel with a supplied temperature. confirmed

VC-OB-1-CERT-v2: prop:s2-vac, thm:s2-sep, prop:v2-VC-renorm All present in v2 (prop:v2-VC-renorm not in v1). thm:s2-sep calls its family a ``conformal warp''; Hawk07 CERT v3 records that this name is a misnomer for the same slice-rescaling family (Hawk07-F-CERT-v3 rem:v3-name); not cited here otherwise. confirmed, noted

prop:v2-VC-renorm ``enlarges the renormalization fibre by curvature counterterms'' It enlarges the fibre by the tensors of def:v2-H; in VC-OB-1-CERT-v2's own convention these have nonzero divergence (check C20), unlike the parent's *^{(1)}H*; the description fits the intended tensors only. Same error as Hawk07 CERT v2, corrected in its v3. corrected; T266.1

prop:v3-origin: two-point minimax under $H_B \to H_B + cI$ True (version 3); restated through Lemma . confirmed

Red06-G-DSS-CERT-v3 thm:RC-coef: *T^{(varkappa)}, S^{(varkappa)}* on a prescribed host; ``same form'' as thm:th-cert Present; admitted data *H, c, G, k_B* of *DSS_H*. Same injectivity form, but unbounded targets with infinite worst-case error; the analogue here is βQ_L, not the bounded Q_L (Proposition). qualified; T266.2

Energy gain finite worst-case error, βQ infinite Re-checked against Theorem (c),(d): Q_L bounded, error $\varepsilon/4$; βQ_L unbounded. confirmed

Cross-sheet: ``the form is the same; the hosts and the named quantities differ'' True between this sheet and the de Sitter sheets; false inside the de Sitter group: DS-OB-1-CERT-v2 thm:DS-coef6, Red06-G-DSS-CERT-v3 thm:RC-coef and Big01-A share *DSS_H*, and the first two share the label formulas. corrected; T266.3

Companion versions Red06-G-DSS-CERT-v4 is delivered and newer than the v3 named; cited statements unchanged. Only v2 of the OB sheets is delivered. noted

bottomrule

Plan corrections of version 4, and errors found in version 3

T266.1 prop:v2-VC-renorm enlarges the fibre by the displayed tensors of def:v2-H, which are not divergence-free in that sheet's convention (check C20); ``by curvature counterterms'' fits the parent VC-OB-1 and the intended tensors, not the display.

T266.2 thm:RC-coef has the same injectivity form as Theorem , but its targets are unbounded; it matches the βQ_L statement, not the Q_L statement.

T266.3 The line ``the hosts and the named quantities differ'' is false inside the de Sitter group (DS-OB-1-CERT-v2, DSS CERT-v3, Big01-A share *DSS_H*).

Errors found in version 3.

V3E.1 Version 3 said that VC-OB-1-CERT-v2 prop:v2-VC-renorm ``states the same'' as the parent's VC-OB-1 prop:VC-renorm2. The fibres are not the same: the CERT's *^{(1)}H* differs from the parent's in the signs of the two algebraic terms, and the CERT's tensors are not divergence-free in its convention (check C20). The version-3 file is not edited.

Version 5: the items of request t267u, and errors found in version 4

No plan was attached to request t267u, so version 5 has no plan audit. The request asked that the items left open by the version-4 report be addressed honestly; this table records where each is treated and with what status (proved, partial, open, or not applicable to this sheet). Missing is never zero. toprule Item Treatment here Status

midrule Which VC-OB-1-CERT fibre statements survive with corrected tensors Theorem and Proposition : (a) survives as far as it is negative, (b) survives, (c) survives with the values -360, -120 (C25) proved; conservation of *E^{(2)}* *partial*

Rank-one duals; non-classical decoders Statements of the I-C channel sheets; not of this sheet n/a here

I-B-G-Q-C: Δ_4 and the running constant Treated in I-B-G-Q-C-CERT-v5 n/a here

Readings: VC-OB-1-CERT-v3, DS-OB-1-CERT-v3, Red06-G-DSS-CERT-v4, Hawk07-F-CERT-v3 Section , documentary done

bottomrule

Errors found in version 4. None found. The version-4 statements about VC-OB-1-CERT-v2 (the divergence

2160, the parent's sign difference, survival of part (b)) agree with VC-OB-1-CERT-v3 and with Theorem . The version-4 open item ``which statements survive with corrected tensors" is now answered (Proposition), except the conservation of *E^{(2)}*. The version-4 file is not edited.

Version 6: the items of request t268u, and errors of earlier versions

No plan was attached to request t268u, so version 6 has no plan audit. The request asked that the items left open by version 5 be targeted and that the newest companion sheets be read; this table records where each item is treated and with what status (proved, partial, open, conditional, or not applicable to this sheet). Missing is never zero. toprule Item Treatment here Status

midrule Conservation of *E^{(2)}* (version 5: partial) Hand proof, Theorem ; Corollary makes Proposition (a) full proved

Collapse of the fibre beyond Einstein regions Radiation metric, Proposition partial ((b) computer-assisted)

Exact finite minimax values on the enlarged fibre Not re-examined *open*

Rank-one duals; (Hdil) Statements of the other sheets n/a here

Readings: VC-OB-1-CERT-v4, Hawk07-F-CERT-v4, DS-OB-1-CERT-v4, DSS CERT v5 Section , documentary; E6.1 below done

Two readings of the version-2 displays (VC-OB-1-CERT-v4 vs. version 5) Proposition : both correct, opposite curvature signs proved

Readings, second wave: OB-1-CERT-v5, Hawk07-*-CERT-v5, DSS CERT v6 Section , documentary done

bottomrule

Errors of earlier versions found in version 6.

E6.1 (Version 4, reading of Red06-G-DSS-CERT.) The sentence ``Red06-G-DSS-CERT-v4 is delivered; thm:RC-coef and prop:RC-dyn are unchanged from v3" is true of the text but omits the version-4 erratum that prop:RC-dyn(d) needs the normalization $\varphi(0) = 0$ or the stated rescaling (Red06-G-DSS-CERT-v4 app:RC-errors), as Red06-G-DSS-CERT-v5 doc:RC-icrow5 points out for the I-C rows. thm:RC-coef is unaffected, and no statement of this sheet uses prop:RC-dyn. No statement of version 5 was found false. Resolved rather than corrected: the version-5 non-claim ``the conservation of *E^{(2)}* is not proved here" and the proviso of Proposition (a) (Theorem , Corollary). The second-wave companions (OB-1-CERT-v5, Hawk07-*-CERT-v5, DSS CERT v6) record no error in version 5 of this sheet; their readings of it were checked and found accurate. The earlier files are not edited.

Audit of the parent, checks, and non-claims

Audit of the parent. I-C-Th-v1 thm:underdetermination, I-C-Th-v1 lem:replacement and I-C-Th-v1 thm:thermal with their proofs were re-read; no mathematical error was found. One source-level defect was observed: the parent's preamble defines verb | AA | with verb | newcommand |, which raises the LaTeX error ``Command verb | AA | already defined"; because the kernel meaning survives, its bibliography still prints Aberg correctly. The parent is not revised.

Computer-assisted checks. Appendix lists floating-point checks of the witness (C8) and, new in version 2, of the balance, the implementation separation, the shift invariance and the midpoint rule (C13), and, new in version 3, of the implementation fibre (C19). They are computer-assisted, corroborate the proofs, and no proof depends on them. No independent review has been performed. Checks C20 (exact, sympy: divergence of the displayed curvature tensors) and C24 (radius lemma on grids) are new in version 4. Check C25 (exact, sympy: the corrected tensors *E^{(1)}*, *E^{(2)}*, their null contractions and divergences on two test metrics, and the identities of Theorem (b)) is new in version 5. Version 6: check C35 (exact, sympy: $\nabla \cdot E^{(1)} = \nabla \cdot E^{(2)} = 0$ and the intermediate identity of Theorem at a point of two non-diagonal metrics; $E^{(1)} = E^{(2)} = 0$ on the radiation metric; both readings of the display *^{(2)}H*, Proposition) is new.

Open. A physically identified reservoir, implementation or temperature; any absolute energy or vacuum energy; O.1, Gate 0, XV-B, J2, U6-sel and Host C, unchanged. Version 4: which statements of VC-OB-1-CERT about its

renormalization fibre hold with corrected tensors (its version 3 was not read); a derived temperature of any host stays excluded. Version 5: the conservation of $E^{(2)}$ (partial; corroborated by C25 on two metrics); exact finite minimax values on the enlarged fibre (not re-examined). Version 6: a hand proof of $E^{(2)} = 0$ on the radiation metric (computer-assisted only); exact finite minimax values on the enlarged fibre.

Non-claims. This sheet does not imply a temperature of any host, a derived β, a thermal state of any horizon, an Einstein equation, or any admitted quantum coefficient. It does not imply that the energy gain has infinite worst-case error. Nothing here closes an open item of the parent or any standing gate. Host stays prescribed, labels stay named.

References

D. Reeb and M. M. Wolf, An improved Landauer principle with finite-size corrections, *New J. Phys.* 16 (2014) 103011; arXiv:1306.4352.

I-C-Th-v1, *Three Ledgers for Destructive Readout*; title page names Ngo Cheung. Parent sheet; source record only.

VC-OB-1 (version 5), obstruction sheet for Plan 13; source record only.

Big01-A (version 5), *Horizon-Bounded Capacity on a Prescribed de Sitter Host*; title page names Ngo Cheung (authorship requires confirmation). Source record only.

appendix

Label audit

Every cited label of a parent or source sheet was found as a verb || in the read-only copy listed in Appendix (automated; 57 labels, 0 missing). Labels that the plan names but that do not exist are recorded as plan corrections. begingroup toprule Sheet Label Found

midrule endhead Big01-A prop:Dyncert yes

Big01-A thm:Bthermal yes

DS-OB-1-CERT-v2 thm:DS-coef6 yes

DS-OB-1-CERT-v3 prop:v3-DS-orbit yes

DS-OB-1-CERT-v3 prop:v3-DS-renorm yes

DS-OB-1-CERT-v5 lem:v5-display yes

Hawk07-F-CERT-v3 cor:v3-fibre yes

Hawk07-F-CERT-v3 prop:v3-E yes

Hawk07-F-CERT-v3 rem:v3-name yes

Hawk07-F-CERT-v3 sec:cert-errors yes

Hawk07-F-CERT-v4 prop:v4-Evar yes

Hawk07-F-CERT-v4 thm:v4-nullchar yes

Hawk07-F-CERT-v5 lem:v5-scalarflat yes

Hawk07-F-CERT-v5 thm:v5-frw yes

I-C-Th-CERT-v2 thm:th-cert yes

I-C-Th-CERT-v4 lem:v4-radius yes

I-C-Th-CERT-v4 prop:v4-types yes

I-C-Th-CERT-v5 lem:v5-mono yes

I-C-Th-CERT-v5 prop:v5-survive yes

I-C-Th-CERT-v5 thm:v5-E yes

I-C-Th-v1 eq:thermal yes

I-C-Th-v1 lem:replacement yes

I-C-Th-v1 spec:package yes

I-C-Th-v1 thm:release yes

I-C-Th-v1 thm:thermal yes

I-C-Th-v1 thm:underdetermination yes

Red06-G-DSS-CERT-v2 thm:RC-coef yes

Red06-G-DSS-CERT-v3 thm:RC-coef yes

Red06-G-DSS-CERT-v4 app:RC-errors yes

Red06-G-DSS-CERT-v4 doc:RC-thermal yes

Red06-G-DSS-CERT-v5 doc:RC-icrow5 yes

Red06-G-DSS-CERT-v6 doc:RC-v6read yes

Red06-G-DSS-CERT-v6 prop:RC-geod yes

V-DST-DSS-CERT-v5 prop:VDC-E1 yes

V-DST-DSS-CERT-v6 doc:VDC-v6read yes

V-DST-DSS-CERT-v6 prop:VDC-even yes

VC-OB-1 prop:VC-renorm yes

VC-OB-1 prop:VC-renorm2 yes

VC-OB-1 thm:VC-fibre yes

VC-OB-1 thm:VC-main yes

VC-OB-1-CERT-v2 def:v2-H yes

VC-OB-1-CERT-v2 prop:VCc-fibres yes

VC-OB-1-CERT-v2 prop:v2-VC-renorm yes

VC-OB-1-CERT-v2 thm:VCc-fibre yes

VC-OB-1-CERT-v3 cor:v3-VC-hawk yes

VC-OB-1-CERT-v3 def:v3-E yes

VC-OB-1-CERT-v3 lem:v3-Ediv yes

VC-OB-1-CERT-v3 prop:v3-VC-H yes

VC-OB-1-CERT-v3 prop:v3-VC-alltime yes

VC-OB-1-CERT-v3 prop:v3-VC-late yes

VC-OB-1-CERT-v3 prop:v3-VC-renorm0 yes

VC-OB-1-CERT-v4 cor:v4-Hnorm yes

VC-OB-1-CERT-v4 cor:v4-VC-fibre yes

VC-OB-1-CERT-v4 thm:v4-E2div yes

VC-OB-1-CERT-v5 lem:v5-display yes

VC-OB-1-CERT-v5 prop:v5-einstein-n yes

VC-OB-1-CERT-v5 thm:v5-vac yes

bottomrule endgroup

Computer-assisted checks

All checks in this appendix are computer-assisted (floating point, mpmath, sympy, scipy). They corroborate the proofs, and no proof depends on them. The selection is made by C-common/code/ic_select.py from C-common/code/ic_checks.py (C1–C8, version 1), ic_checks2.py (C9–C13, version 2), ic_checks3.py (C14–C19, version 3) and ic_checks4.py with ic_checks4_curv.py (C20–C24, version 4) and ic_checks5.py with ic_checks5_curv.py (C25–C29, version 5) and ic_checks6.py with ic_checks6_curv.py (C30–C35, new in version

6). Script code/checks.py, output logs/checks.json. begingroup toprule Id Content Result

midrule endhead C8 thermal witness eps=1: dQ_L/dbeta>0 on (0,30], range (1/2,1), best constant rule 3/4 with worst-case error 1/4 (grid), beta Q_L increasing and unbounded on the grid OK ({"Qmax": 0.9999999999999065, "Qmin": 0.50000025, "argmin_R": 0.75, "betaQ_increasing": true, "betaQ_max_on_grid": 29.999999999997197, "minimax_grid": 0.24999999999990652, "strictly_increasing": true})

C13 qubit witness eps=1, beta in (0.2,1,3): balance beta Q_B = Delta S_M + I + D for SWAP, identity and a partial-swap energy-conserving U; SWAP bills >0, identity bills 0; Q_B invariant under H_B -> H_B + c I; partial swap: minimax constant rule error = half the range <= spectral width (grid) OK ({"half_range": 0.07881559388199955, "identity_bills": [0.0, 0.0, 0.0], "max_balance_dev": 1.3877787807814457e-16, "max_shift_dev": 2.220446049250313e-16, "minimax_grid": 0.07881559388199957, "random_U_range": [0.15764695167095766, 0.31527813943495675], "swap_bills": [0.5498339973124778, 0.7310585786300049, 0.9525741268224333], "width": 1.0})

C19 qubit, eps=1: 10 random energy-conserving unitaries and random beta: Q = |b|\{}2 Q_swap(beta) to 1e-12; four pairs (beta,s) with the same bill Q=0.4 OK ({"max_dev": 2.220446049250313e-16, "same_bill_pairs": [[0.5, 0.642612], [1.0, 0.547152], [2.0, 0.454134], [5.0, 0.402695]]})

C20 exact (sympy): curvature conventions with R=12K\{}2 on de Sitter; on -dt\{}2+exp(2t\{}3/3)dx\{}2 the displayed (1)H and (2)H of VC-OB-1-CERT-v2 def:v2-H have nonzero divergence, while the parent VC-OB-1 (1)H and both tensors with the derivative terms reversed are divergence-free OK ({"H1cert_cons": false, "H1par_cons": true, "H1rev_cons": true, "H2cert_cons": false, "H2rev_cons": true, "R_dS": "12*K**2", "divt_H1_t1": "2160"})

C24 radius lemma on grids: Q_L (eps=1) has radius 1/4 with best constant 3/4; e(beta)=1-1/(2+2cosh beta) (gap 1) is increasing with values in (3/4,1) and radius 1/8; beta Q_L reaches the grid end OK ({"bQ_max_on_grid": 30.0, "best_const_Q": 0.75, "radius_Q": 0.249987, "radius_e": 0.125})

C25 exact (sympy): for E1, E2 of VC-OB-1-CERT-v3 def:v3-E, on -dt\{}2+exp(2t\{}3/3)dx\{}2 with null k=d_t+exp(-t\{}3/3)d_x at t=1, E1(k,k)=-360 and E2(k,k)=-120; div E1=div E2=0 on that metric and on a Bianchi-I metric; div of the displayed (1)H of VC-OB-1-CERT-v2 equals 4 Ric(grad R), (1)H=E1+4(dd R-g Box R) and (2)H=-E2+4 Ric.Ric-g|Ric|\{}2 on both; E1=E2=0 on de Sitter (R=12K\{}2) OK ({"BI_Hid": true, "BI_divE1": true, "BI_divE2": true, "BI_divH1": true, "E1kk": "-360", "E2kk": "-120", "Hid": true, "dS_E0": true, "dS_R": "12*K**2", "divE1": true, "divE2": true, "divH1": true})

C35 exact (sympy, truncated Taylor arithmetic at the origin of two non-diagonal polynomial metrics): div E1 = div E2 = 0 and the intermediate identity for nabla\{}mu Box R_{mu nu} of the hand proof holds (and is nonzero); on the radiation metric eta\{}2(-d eta\{}2+dx\{}2+dy\{}2+dz\{}2): R=0, Ric nonzero, E1=E2=0; both readings of the version-2 display of (2)H hold at the origin (unprimed: (2)H = -E2 + 4 Ric.Ric - g|Ric|\{}2; curvature sign reversed: (2)H = E2) OK ({"A": {"H2_primed": true, "H2_unprimed": true, "R0": "671/490", "divE1": ["0", "0", "0", "0"], "divE2": ["0", "0", "0", "0"], "identity": true, "identity_nontrivial": true, "lhs": ["50557/246960", "-2515727/1481760", "357113/1646400", "-2183801/5927040"]}, "B": {"H2_primed": true, "H2_unprimed": true, "R0": "-9/7", "divE1": ["0", "0", "0", "0"], "divE2": ["0", "0", "0", "0"], "identity": true, "id...)

bottomrule endgroup Result: 7 of 7 checks OK.

Artifact hashes (sha256)

begingroup toprule File sha256

midrule endhead inputs/Big01-A-v5.api.tex
e1160613ea8e02b37fb45954fe677d89f5fa7cca90062d42b68973b03a2bff1d

inputs/DS-OB-1-CERT-v2.tex 748b382d5959123890ac320e22295c3d87609b3da73496cc85cdbfbabde2633f

inputs/DS-OB-1-CERT-v3.tex 07b600a11b5ec1661b651f74d473d270aa6e114463da94f051c630dd7b1758ea

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inputs/Hawk07-A-CERT-v5.tex 9db43c8772a84fcf2fcf8d3674b86781ab407b93de05d370740e89f3f00b7add
inputs/Hawk07-F-CERT-v3.tex 2280220e1bddd21e787032d88903764932f23d06bc5100722b08891a9c536dd6
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parts/04_plan.tex 2ff0c0149c1f719282bee697a761f2fe5aceec8d7b11805e7b372f3475f16bd5

logs/checks.json 3f583ec47f5431c9a2ca8cbf825992d169e32b4abfdbd8a4899719d7613918fe

logs/inputs.sha256 f0820a7cd0c9b80e4f31e1e97526eb7a68cb51256747f1c63578a1ef1cc13d0f

../C-common/code/ic_checks.py 912c95e4b1db7998f312426da001034368de6c3dd64e0fb4a9a42b7e53021bbf

../C-common/code/ic_checks2.py 1f5f5c348b1c711e6466347e12904db433a889a4247c94d378fb9275e38c2da7

../C-common/code/ic_select.py 8bc20e667e8571b0f6f78b5e6ea3168fb9e815186613d2c07735690b4ec5729e

../logs/get_log_S1.txt f4ad94933a9086eed368e50d2b7a5d9ea1b22ded9a1a07ec55ad12d5fb4872ac

../logs/get_log.txt f639ab99a753eed5217b1d001fe5cfa88a1c4191f4c4c7b89decb05f71514108

../logs/plan_label_audit.json f59bffdb66c63c8e64734a5490205357ea03fe78ea6108abed0d05b9365ef86b

../C-common/code/ic_checks3.py d2661722e5dfa7a3493a3d1a7f7b15db2f20db64e6fca34eb6641d62d90b4fca

../logs/get_log_S1v2.txt 470a182c91cdb81697779de8edc5498d31b4806ce398ca65e9481e46d6214683

../C-common/code/ic_checks4.py 5e573a4fa9fdee85ae57225cad0d652b0ae87e26a0213902433278467228b204

../C-common/code/ic_checks4_curv.py 355487e6b9e2d97d373cef95ab4849b155069a05b6357c19427c8517adab0365

../C-common/code/ic_checks5.py fb661fa24dca783522dd2a86bd39a4b5d178f840d6539c2a865ba730e4e532bb

../C-common/code/ic_checks5_curv.py 3c08d86437024cb0ed1f1031fb7409b055de461517d0b92e21f16a27f484b13d

../C-common/code/ic_checks6.py d883c43acada82668fa5dc4f51d8f9437aafe1d701fa88b11855df075a7db81e

../C-common/code/ic_checks6_curv.py 5436c6c1011618c22e8ac3e57b13c865108b0a7def56cf1f842d8d3efbe1d7c1

midrule Frozen tree (before)

XVI-P ec965c15ae25cd3bb9cc2b3a134e966b19a1803c78d1fe5bf7554da2a8b3aaa6 OK

XVI-Q 0df9a0d10409d31ac0c2d0a47197e3f6e03c7ae258ec5fb775137f66cb0493c4 OK

XVI-R 57187bc6825f5c6ae88633b7279c6c0be57f7c4918fdbc525da4aaf958331edb OK

bottomrule endgroup The hashes of the delivered .tex and PDF are recorded in MANIFEST-CertPlan-S1v6.sha256, not here, because a file cannot contain its own hash.