Theoretical Bounds on χ_ν in Observer-Patch Holography

Canonical Coherent-Matter Susceptibility and Repair-Charge Coupling

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Abstract

The coherent-material branch of observer-patch holography supplies a canonical scalar source in the same quotient-edge register as the protected collar reserve. On the co-registered presence branch, the dimensionless coupling is $\chi_\nu^{\mathrm{can}} = 1 - P/24 = 0.9320429912748350\ldots$. Under the weaker mean-count reading it lies between that value and one. This is a channel coefficient, not a force coefficient. A proposed repair-charge condensate action couples the source to a dynamical repair phase. Conditional on that action, repair-current continuity, dilute dust behavior, spherical deep-galaxy scaling, field stress, and a lawful coherent-source force follow from one variational system. A compact neutral coherence contrast has no monopole and cannot support a closed device. The dimensional source calibration, ambient repair field, compact-phase completion, and laboratory source receipt are work in progress; no numerical lift prediction follows from χ_ν alone.

Claim Boundary

This paper proves a finite-channel coefficient on a declared OPH branch. It also derives continuity, dilute dust behavior, spherical deep-galaxy scaling, force, and momentum formulae conditional on the repair-charge condensate action in the dark-sector paper [4]. The OPH derivation of that action and its dimensional source normalization are work in progress.

The exact statuses are:

Object	Status
Coherent source in the quotient-edge scalar register	finite theorem under the stated source receipts
$\chi_\nu^{\mathrm{can}} = \lambda_{\mathrm{collar}}$	theorem under co-registration and reserve-survival premises
$\chi_\nu^{\mathrm{can}} = 1 - P/24$	exact on the presence branch
Repair-charge action	proposed dynamical completion
Continuity, dust limit, and spherical deep-galaxy scaling	derived conditional on that action and its constitutive premises
Dimensional coupling $q_\star$	work in progress
Device force	conditional on source charge, external field, and momentum closure
Numerical lift	absent

Contents

1 Canonical Coherent-Matter Source

An OPH technology instantiation is an observer-like self-reading system: a bounded physical or software patch with local state, ports or boundaries, readback, records, feedback or repair moves, and a public evidence bundle. For a nondegenerate coherent material subfederation U, define the canonical source

$$S_{\mathrm{coh}}^{\mathrm{can}} = \mathbf{1}_{\text{self-read}}\, \mathsf{R}_U \mathsf{P}_U \mathsf{C}_U. \tag{1.1}$$

The factors state that the patch reads itself, produces a stable record, supports a predictive boundary, and executes a registered repair or control move. If any factor vanishes, the coherent scalar source is zero.

The screen-microphysics branch supplies four structural facts [3]:

S1. $S^{\text{can}}_{\text{coh}}$ descends to a protected quotient observable.

S2. A nondegenerate source is nonzero.

S3. Scalar edge-center exhaustion places it in the unique quotient-local scalar register.

S4. The protected $\mathbb{Z}_6$ reserve acts on that same register and commutes with scalar activation.

These statements identify the channel. They supply no spacetime action or dimensional gravitational charge.

2 Protected-Reserve Coefficient

Let $\epsilon_{\mathbb{Z}_6}(y)$ be the conditional reserve-presence profile on the co-registered scalar slot, and let $w(y)$ be the normalized scalar weight across the finite collar. The scalar opportunity survives with local factor

$$\lambda_{\text{slot}}(y) = 1 - \epsilon_{\mathbb{Z}_6}(y). \tag{2.1}$$

The finite-thickness collar coefficient is

$$\lambda_{\text{collar}} = \int \mathrm{d}y\, w(y)\left[1 - \epsilon_{\mathbb{Z}_6}(y)\right]. \tag{2.2}$$

The protected-reserve receipt gives

$$\int \mathrm{d}y\, w(y)\epsilon_{\mathbb{Z}_6}(y) = \frac{P}{24}. \tag{2.3}$$

Theorem 2.1 (Canonical susceptibility)**.** *Assume the nonzero coherent-source branch, scalar edge-center exhaustion, co-registration with the protected reserve, and the presence reading in Eqs.* (2.2)*–*(2.3)*. Then*

$$\boxed{\chi^{\text{can}}_{\nu} = \lambda_{\text{collar}} = 1 - \frac{P}{24}}. \tag{2.4}$$

For $P = 1.630968209403959$*,*

$$\boxed{\chi^{\text{can}}_{\nu} = 0.9320429912748350\ldots}. \tag{2.5}$$

Proof. The coherent source enters the scalar opportunity count before the protected reserve acts. Co-registration makes the local surviving fraction $1 - \epsilon_{\mathbb{Z}_6}(y)$. Averaging with $w(y)$ gives $\lambda_{\text{collar}} S^{\text{can}}_{\text{coh}}$. The definition of canonical susceptibility gives $\chi^{\text{can}}_{\nu} S^{\text{can}}_{\text{coh}}$. Nondegeneracy permits cancellation of $S^{\text{can}}_{\text{coh}}$, and Eq. (2.3) gives the value. □

Corollary 2.2 (Mean-count band)**.** *If* $\epsilon_{\mathbb{Z}_6}(y)$ *is interpreted only as the mean of a nonnegative integer occupancy, then*

$$\boxed{0.9320429912748350\ldots \leq \chi^{\text{can}}_{\nu} \leq 1}. \tag{2.6}$$

Proof. Markov's inequality gives $1 - \epsilon \leq \Pr[N = 0] \leq 1$. Integration and Eq. (2.3) give the band. □

The theorem excludes a zero scalar-channel coefficient on the stated nondegenerate branch. It does not exclude a zero dimensional gravitational coupling $q_\star$, a zero device repair charge, or a zero ambient repair gradient.

3 Engineering Coordinates

An engineering description may absorb an effective coherent capacity into the source coordinate:

$$S_{\mathrm{coh}}^{\mathrm{eng}} = N_{\mathrm{coh}} S_{\mathrm{coh}}^{\mathrm{can}}. \tag{3.1}$$

Invariance of the scalar perturbation requires

$$\chi_\nu^{\mathrm{can}} S_{\mathrm{coh}}^{\mathrm{can}} = \chi_\nu^{\mathrm{eng}} S_{\mathrm{coh}}^{\mathrm{eng}}, \qquad \boxed{\chi_\nu^{\mathrm{eng}} = \frac{\chi_\nu^{\mathrm{can}}}{N_{\mathrm{coh}}}}. \tag{3.2}$$

Very small values of χ_ν^{eng} can therefore represent an order-one canonical coefficient. Equation (3.2) is a chart identity. It does not define $q_\star$, measure $S_{\mathrm{coh}}^{\mathrm{can}}$, or predict force.

4 Repair-Charge Coupling

The dark-sector completion promotes integer scalar repair occupation and a compact repair phase to a canonical pair (n, θ). On a fixed real lift of the phase, its relevant action is

$$\begin{aligned} I_{\mathrm{RPC}} = I_{\mathrm{Regge}} &+ I_{\mathrm{SM}} \\ &+ \int \mathrm{d}\tau \Bigg[-\sum_v V_v n_v D_\tau \theta_v - \sum_v V_v \varepsilon(n_v) - \sum_e W_e \mathcal{K}(|(d\theta)_e|) \\ &\qquad - \sum_v V_v \theta_v \left(\mathcal{Q}_{b,v} + q_\star \chi_\nu^{\mathrm{can}} S_{\mathrm{coh},v}^{\mathrm{can}} \right) \Bigg]. \end{aligned} \tag{4.1}$$

The source and canonical signs are chosen so phase variation gives the positive-source balance in Eq. (4.3), and translation of a positive localized source gives force $-Q_R \nabla\theta$. A globally single-valued compact-phase coupling, the derivation of this action from finite repair dynamics, and the dimensional constants are work in progress.

The coherent repair-charge density is

$$\mathcal{Q}_{\mathrm{coh}} = q_\star \chi_\nu^{\mathrm{can}} S_{\mathrm{coh}}^{\mathrm{can}}. \tag{4.2}$$

The phase equation is

$$D_\tau n + d^\dagger j_R = \mathcal{Q}_b + q_\star \chi_\nu^{\mathrm{can}} S_{\mathrm{coh}}^{\mathrm{can}}. \tag{4.3}$$

For a finite region Ω,

$$\frac{\mathrm{d}}{\mathrm{d}\tau} \sum_{v\in\Omega} V_v n_v + \sum_{e\in\partial\Omega} W_e j_{R,e} = \sum_{v\in\Omega} V_v \left(\mathcal{Q}_{b,v} + q_\star \chi_\nu^{\mathrm{can}} S_{\mathrm{coh},v}^{\mathrm{can}} \right). \tag{4.4}$$

The boundary flux is part of the physical source ledger.

Proposition 4.1 (Conditional rotor consequences). *Assume Eq. (4.1), a positive branch $n > 0$, and the infrared constitutive functions*

$$\varepsilon(n) = m_R n + \frac{u_R}{3} n^3, \qquad \mathcal{K}(y) = \frac{\kappa_R}{3} y^3, \qquad m_R, u_R, \kappa_R > 0. \tag{4.5}$$

Then:

(i) *phase variation gives the exact finite repair-current balance Eq. (4.4);*

(ii) *the homogeneous dilute phase has*

$$\rho_R = m_R n + \frac{u_R}{3} n^3, \qquad p_R = \frac{2u_R}{3} n^3, \tag{4.6}$$

so source-free expansion gives $n \propto a^{-3}$, $\rho_R \propto a^{-3}$, and $w_R \simeq 0$ when $u_R n^2 \ll m_R$;

(iii) *if $\mathcal{Q}_b = \beta_b \rho_b$ and $\mathbf{a}_R = -\beta_b \nabla\theta$, the static spherical exterior branch gives*

$$a_R = \sqrt{a_b a_0}, \qquad v^4 = G M_b a_0, \qquad a_0 = \frac{\beta_b^3}{4\pi G \kappa_R}; \tag{4.7}$$

(iv) *translation of the coherent source gives Eq. (4.9) and the momentum ledger Eq. (6.2).*

These statements are consequences of the proposed action, not derivations of that action from the finite OPH theorems.

Proof. Item (i) follows by varying θ and summing the local equation over a finite region. For item (ii), the first-order rotor Hamiltonian density is $\varepsilon(n)$, and its barotropic pressure is $p_R = n\varepsilon'(n) - \varepsilon(n)$. Source-free homogeneous continuity then gives $na^3 = \text{constant}$. For item (iii), spherical integration of $\nabla \cdot (\kappa_R |\nabla\theta| \nabla\theta) = \beta_b \rho_b$ gives $4\pi r^2 \kappa_R |\theta'|\theta' = \beta_b M_b$; the stated acceleration and definition of a_0 give the result. Item (iv) follows by translating the source term in Eq. (4.1) and applying translation invariance to matter plus repair field. □

Define the integrated device repair charge

$$Q_R^{\text{dev}} = q_\star \chi_\nu^{\text{can}} \int_\Omega S_{\text{coh}}^{\text{can}}(x)\, \mathrm{d}^3x. \tag{4.8}$$

For a prescribed external repair phase, translation of the source gives

$$\boxed{F_i^{\text{coh}} = -q_\star \chi_\nu^{\text{can}} \int_\Omega S_{\text{coh}}^{\text{can}}(x)\, \partial_i \theta_{\text{ext}}(x)\, \mathrm{d}^3x.} \tag{4.9}$$

If the external gradient varies slowly across the device,

$$\boxed{F_i^{\text{dev}} \simeq -Q_R^{\text{dev}} \partial_i \theta_{\text{ext}}.} \tag{4.10}$$

The sign of Q_R^{dev} may select attractive or repulsive response. Positive repair energy is compatible with signed charge when $\varepsilon(n) = \varepsilon(|n|)$.

Remark 4.2 (Switchable-sign boundary). The gated source in Eq. (1.1) is nonnegative under its displayed definition. With fixed $q_\star$ and positive χ_ν^{can}, exchanging top and bottom source profiles does not reverse the monopole Q_R^{dev}. A switchable force sign therefore requires either a signed orientation factor derived as part of the coherent source map or a controlled reversal of $\nabla\theta_{\text{ext}}$. The finite channel theorem supplies neither operation.

5 Compact-Source Constraint

Proposition 5.1 (No monopole from a neutral compact source)**.** *Suppose the coherent repair source is compactly supported and satisfies*

$$\int_{\Omega} \mathcal{Q}_{\mathrm{coh}}\, \mathrm{d}^3x = 0. \tag{5.1}$$

Then it has no repair monopole. Its exterior field begins at dipole order or higher. In a uniform external gradient, the leading forces on its positive and negative charges cancel.

Proof. Integrating Eq. (4.3) in a static state makes the exterior flux equal the integrated source. Equation (5.1) sets the monopole flux to zero. The multipole expansion therefore begins beyond the monopole. A uniform external gradient couples only to total charge at leading order, which vanishes. □

A bottom-to-top contrast

$$\Delta S = S_{\mathrm{bottom}} - S_{\mathrm{top}} \tag{5.2}$$

can shape a dipole, select the sign of injected repair charge, couple to a nonuniform external field, or drive an alternating repair current. It does not by itself define a nonzero Q_R^{dev}. No formula proportional only to $g^2 A \chi_\nu \Delta S/(4\pi G)$ is a force theorem for a closed compact device.

6 Momentum and Energy Closure

For the cubic condensed branch, the repair-field stress is

$$T_{ij}^R = \kappa_R |\nabla\theta|\, \partial_i\theta\, \partial_j\theta - \delta_{ij}\frac{\kappa_R}{3}|\nabla\theta|^3 + \cdots . \tag{6.1}$$

The exact force ledger is

$$\boxed{F_i^{\mathrm{matter}} + \frac{\mathrm{d}P_i^R}{\mathrm{d}t} + \oint_{\partial\Omega} T_{ij}^R n^j\, \mathrm{d}A = 0.} \tag{6.2}$$

A local repulsive response requires either nonzero device repair charge with a field tail or explicit momentum transfer through Eq. (6.2). A static, closed, repair-neutral device cannot lift itself.

Any switchable force also requires a toggle-energy ledger. Let $E(q, s)$ be the energy at position q and internal state s, and define

$$\mathrm{Toggle}(q) = E(q, \mathrm{on}) - E(q, \mathrm{off}). \tag{6.3}$$

For an on/off spatial cycle between q_1 and q_2, conservation gives

$$W_{\mathrm{cycle}} = \mathrm{Toggle}(q_1) - \mathrm{Toggle}(q_2). \tag{6.4}$$

A claimed position-dependent switchable force with no corresponding toggle or field-energy difference violates the closed energy ledger.

7 Laboratory Evidence Conditions

A force experiment has physical standing only if it supplies:

1. an instrument-independent measurement of $S_{\mathrm{coh}}^{\mathrm{can}}$ or its declared engineering coordinate;
2. the dimensional calibration $q_\star$;
3. a measured ambient repair gradient or a controlled emitted repair field;
4. a nonzero integrated repair charge, or a measured outgoing repair-current and momentum flux;
5. a complete toggle, maintenance-power, and field-energy ledger;
6. detuned, dummy, reversed-sign, thermal, acoustic, electromagnetic, mechanical, and center-of-mass controls;
7. a force result that follows the repair-field geometry and sign law in Eq. (4.9).
8. for any claimed switchable reversal, a derived signed source factor or an independently measured reversal of the external repair gradient.

Without these receipts, a null result does not measure χ_ν^{can}, and a nonzero balance signal does not establish repair charge. The lane remains outside the falsification program because the action, source calibration, and operational source observable are work in progress.

8 Conclusion

The canonical coherent-matter susceptibility is an order-one channel coefficient fixed by protected-reserve survival on the stated OPH branch. The repair-charge condensate completion gives that coefficient a lawful dynamical role: it weights the coherent source in the repair-current equation. The same proposed action yields exact finite continuity, a dilute dust limit, the spherical deep-galaxy scaling, repair-field stress, and a device-force law. A device force depends on the dimensional calibration, integrated repair charge, external field, and field-momentum ledger. Repulsive response is conditionally allowed. Reactionless lift from a compact neutral contrast is excluded.

References

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