Observer-Patch Holography and the Dark Matter Phenomenon

A Repair-Charge Condensate Completion

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Abstract

Observer-patch holography contains a distinguished scalar repair register but does not assign that register a propagation law. This paper states a candidate dynamical completion: integer repair occupation and a conjugate repair phase form a lattice rotor. The proposed action has an exact repair-current balance law and a metric stress tensor. Its dilute homogeneous phase is pressureless, while a cubic condensed-phase link energy gives the deep radial-acceleration law and the baryonic Tully–Fisher scaling. Coherent material couples through the canonical susceptibility χ_ν^{can}, producing a lawful force only through genuine repair charge, an external repair gradient, or explicit field-momentum exchange. The canonical pair, source normalizations, complete constitutive law, relativistic limit, abundance, lensing, CMB, cluster, and laboratory receipts are work in progress. The construction is a conditional dark-sector mechanism, not a closed cosmological prediction.

Claim Boundary

The scalar repair register lives on the federated screen of the OPH carrier stack: each screen cell exposes repair channels beside its ports and records, and the register named here is the scalar sector of that repair machinery, aggregated over the federation. The finite OPH results supply the scalar register, the coherent-material same-channel theorem, and the protected-reserve coefficient

$$\chi_\nu^{\mathrm{can}} = 1 - \frac{P}{24} = 0.9320429912748350\dots. \tag{1}$$

They do not supply a canonical conjugate, kinetic term, stress tensor, baryonic source map, or dimensional coherent-source coupling.

The repair-charge condensate action below is a proposed completion. Given that action, its continuity equation, stress balance, dilute-fluid equation of state, spherical deep-gradient law, and device-force ledger are mathematical consequences. Deriving the action from finite OPH repair dynamics is work in progress. Cosmology remains outside the OPH falsification program.

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1 The Missing Dynamical Object

A scalar channel identifies where a perturbation lives. Dynamics requires a canonical pair. Let the fixed-cutoff OPH carrier be an oriented causal cell complex with sites v, oriented links e, metric-dependent weights V_v and W_e, integer signed repair occupation n_v, and conjugate phase θ_v. The pair obeys

$$n_v \in \mathbb{Z}, \qquad \theta_v \in S^1. \tag{2}$$

The local formulae use a real lift of θ. A global compact-phase completion must make the exponentiated source coupling single-valued. That quantization condition is work in progress.

Let $S^{\rm can}_{{\rm coh},v}$ be the canonical coherent-material source and $\mathcal{Q}_{b,v}$ the baryonic repair demand. The fixed-chart Lorentzian action is

$$\begin{aligned} I_{\rm RPC} = I_{\rm Regge}[\ell] + I_{\rm SM}[\ell,\Psi] \\ + \int \mathrm{d}\tau \Bigg[-\sum_v V_v n_v D_\tau \theta_v - \sum_v V_v \varepsilon(n_v) - \sum_e W_e \mathcal{K}(|(d\theta)_e|) \\ - \sum_v V_v \theta_v \left(\mathcal{Q}_{b,v} + q_\star \chi_\nu^{\rm can} S^{\rm can}_{{\rm coh},v} \right) \Bigg]. \end{aligned} \tag{3}$$

Here $q_\star$ is the dimensional coherent-source calibration. The infrared constitutive functions are

$$\varepsilon(n) = m_R|n| + \frac{u_R}{3}|n|^3 + \cdots, \qquad \mathcal{K}(y) = \frac{\kappa_R}{3} y^3 + \cdots, \tag{4}$$

with $m_R, u_R, \kappa_R > 0$. The omitted terms must provide a positive convex high-gradient completion. Let $D_\tau n_v := V_v^{-1}\partial_\tau(V_v n_v)$, and define the lattice divergence by

$$\sum_v V_v f_v (\mathrm{div}_R\, j)_v = -\sum_e W_e (df)_e j_e \tag{5}$$

for compactly supported f. These conventions make phase variation produce a positive source, and translation of a positive localized source gives $-Q_R\nabla\theta$.

2 Repair Charge, Current, and Stress

Variation with respect to the phase gives

$$D_\tau n + \mathrm{div}_R\, j_R = \mathcal{Q}_b + q_\star \chi_\nu^{\mathrm{can}} S_{\mathrm{coh}}^{\mathrm{can}}, \tag{6}$$

where

$$j_{R,e} = \mathcal{K}'(|(d\theta)_e|)\, \frac{(d\theta)_e}{|(d\theta)_e|}. \tag{7}$$

For the cubic infrared branch,

$$j_{R,e} = \kappa_R |(d\theta)_e| (d\theta)_e. \tag{8}$$

Summation over a finite region Ω gives the exact lattice balance law

$$\frac{\mathrm{d}}{\mathrm{d}\tau} \sum_{v\in\Omega} V_v n_v + \sum_{e\in\partial\Omega} W_e j_{R,e} = \sum_{v\in\Omega} V_v \left(\mathcal{Q}_{b,v} + q_\star \chi_\nu^{\mathrm{can}} S_{\mathrm{coh},v}^{\mathrm{can}} \right). \tag{9}$$

Equation (9) leaves three lawful source classes. A compact neutral source has no monopole and begins at dipole order. A source with nonzero integrated repair charge has a noncompact field tail. A driven source exchanges repair charge and momentum through its boundary. A compact neutral scalar contrast cannot produce a static support force by itself.

In the static cubic branch the spatial stress is

$$T_{ij}^R = \kappa_R |\nabla\theta|\, \partial_i\theta\, \partial_j\theta - \delta_{ij} \frac{\kappa_R}{3} |\nabla\theta|^3 + \cdots. \tag{10}$$

Translation invariance gives the momentum ledger

$$F_i^{\mathrm{matter}} + \frac{\mathrm{d}P_i^R}{\mathrm{d}t} + \oint_{\partial\Omega} T_{ij}^R n^j \,\mathrm{d}A = 0. \tag{11}$$

3 Dilute Homogeneous Phase

Variation with respect to n_v gives

$$D_\tau \theta_v = -\varepsilon'(n_v). \tag{12}$$

On the positive homogeneous branch,

$$\rho_R = m_R n + \frac{u_R}{3} n^3, \qquad p_R = n\varepsilon'(n) - \varepsilon(n) = \frac{2u_R}{3} n^3. \tag{13}$$

For $u_R n^2 \ll m_R$, the repair medium satisfies

$$p_R \ll \rho_R, \qquad \rho_R \simeq m_R n. \tag{14}$$

With no active source, Eq. (6) gives repair-charge conservation. In a homogeneous expanding chart,

$$\dot{n} + 3Hn = 0, \qquad n \propto a^{-3}, \qquad \rho_R \propto a^{-3}, \qquad w_R \simeq 0. \tag{15}$$

The proposed repair medium therefore contains a cold-dark-matter-like background phase. Its abundance and perturbation transfer functions are not fixed by Eq. (15).

4 Condensed Galactic Phase

In a static condensed region, take

$$\nabla\cdot(\kappa_R|\nabla\theta|\nabla\theta) = \mathcal{Q}_b, \qquad \mathcal{Q}_b = \beta_b\rho_b, \qquad \mathbf{a}_R = -\beta_b\nabla\theta. \tag{16}$$

For a spherical baryonic source of mass M_b, the exterior attractive branch satisfies

$$4\pi r^2\kappa_R|\theta'|\theta' = \beta_b M_b, \tag{17}$$

and hence

$$a_R = \sqrt{\frac{\beta_b^3 M_b}{4\pi\kappa_R}}\frac{1}{r}. \tag{18}$$

Define

$$a_0 = \frac{\beta_b^3}{4\pi G\kappa_R}. \tag{19}$$

Then

$$\boxed{a_R = \frac{\sqrt{GM_b a_0}}{r} = \sqrt{a_b a_0}}, \qquad \boxed{v^4 = GM_b a_0}. \tag{20}$$

Thus the cubic link energy implies the deep radial-acceleration relation and the baryonic Tully–Fisher scaling on the stated spherical, static, condensed-phase premises. The complete interpolation, nonspherical dynamics, external-field behavior, and value of a_0 require the full microscopic function $\mathcal{K}$ and the source-derived constants β_b, κ_R.

A single medium with a pressureless normal phase and a MOND-like condensed response also appears in superfluid dark-matter models [4]. Dipolar media provide another action-based example in which cosmological dust behavior and galactic polarization coexist [5]. These analogies establish mathematical precedent, not an OPH derivation.

5 High-Gradient Branch

The constitutive completion may have

$$\mathcal{K}(y) \sim \frac{\kappa_R}{3}y^3 \quad \text{at low gradient}, \qquad \mathcal{K}(y) \sim \frac{\kappa_\infty}{p}y^p, \quad p > 3, \quad \text{at high gradient}. \tag{21}$$

For fixed source flux, the high-power branch makes the field gradient grow sublinearly with source strength. This is a kinetic-screening route rather than a system label. K-mouflage models show that nonlinear kinetic screening can coexist with Solar-System and cosmological constraints, subject to strong parameter bounds [6]. Equation (21) does not establish Solar-System viability. The Sun-plus-Galaxy boundary problem and the relativistic coupling are work in progress.

6 Coherent Matter and χ_ν

The coherent source in Eq. (3) is

$$\mathcal{Q}_{\text{coh}} = q_\star\chi_\nu^{\text{can}}S_{\text{coh}}^{\text{can}}. \tag{22}$$

The coefficient χ_ν^{can} is the dimensionless efficiency with which the canonical coherent source enters the repair-charge channel. It is not a complete force coefficient. The dimensional normalization $q_\star$, the ambient repair field, and the source charge are separate objects.

If an engineering chart uses

$$S_{\mathrm{coh}}^{\mathrm{eng}} = N_{\mathrm{coh}} S_{\mathrm{coh}}^{\mathrm{can}}, \tag{23}$$

then

$$\chi_\nu^{\mathrm{eng}} = \frac{\chi_\nu^{\mathrm{can}}}{N_{\mathrm{coh}}}. \tag{24}$$

This is a coordinate change. It fixes neither $q_\star$ nor a device force.

A coherent source in an external repair field experiences

$$F_i^{\mathrm{coh}} = -q_\star \chi_\nu^{\mathrm{can}} \int_\Omega S_{\mathrm{coh}}^{\mathrm{can}}(x)\, \partial_i \theta_{\mathrm{ext}}(x)\, \mathrm{d}^3 x. \tag{25}$$

Define

$$Q_R^{\mathrm{dev}} = q_\star \chi_\nu^{\mathrm{can}} \int_\Omega S_{\mathrm{coh}}^{\mathrm{can}}\, \mathrm{d}^3 x. \tag{26}$$

For a slowly varying external field,

$$F_i^{\mathrm{dev}} \simeq -Q_R^{\mathrm{dev}} \partial_i \theta_{\mathrm{ext}}. \tag{27}$$

Signed repair charge permits attractive or repulsive response while $\varepsilon(n) = \varepsilon(|n|)$ keeps the onsite energy positive.

A local repulsive response therefore requires either

$$Q_R^{\mathrm{dev}} \neq 0 \tag{28}$$

with its field tail, or nonzero field-momentum transfer in Eq. (11). A static, closed, repair-neutral device cannot support itself through an internal top-to-bottom coherence contrast.

7 Physical Completion Conditions

The conditional mechanism becomes an OPH dark-sector theory only if one construction supplies all of the following:

1. a compact phase canonically conjugate to the scalar repair occupation;
2. a globally well-defined source coupling for the compact phase;
3. the baryonic source map $\mathcal{Q}_b$ from the modular/Borel–Weil gravity bridge;
4. the dimensional coherent-source calibration $q_\star$;
5. a positive convex constitutive law $\mathcal{K}$ covering galactic and high-gradient regimes;
6. a relativistic refinement limit and complete conserved stress tensor;
7. a source-derived cosmic repair abundance and perturbation initial data;

8. CMB, lensing, cluster, merger, growth, and Solar-System likelihoods;
9. an instrument-independent coherent-source observable;
10. a laboratory receipt for nonzero repair monopole charge or outgoing repair-field momentum.

No cosmological target or laboratory lift value is registered. Diagnostic simulations and known-data comparisons carry no falsification verdict while these constructions are work in progress.

8 Conclusion

The proposed scalar repair register is a dynamical rotor with occupation n and phase θ. Its normal phase has pressureless background scaling. Its cubic condensed phase gives the deep galaxy law. Coherent matter enters through the same scalar channel with coefficient χ_ν^{can}, while a lawful device force requires repair charge, an external gradient, and a closed momentum ledger. This unifies the dark-sector and coherent-material mechanisms at the level of one conditional action. The OPH derivation and physical evidence are work in progress.

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