Extrinsic Gravitation as a Homeostat in a CPT-Symmetric Universe: A Proof of Concept

Stephen P. Smith September 2025

Abstract

We propose that gravity, as it appears in Einstein's general relativity, is not entirely intrinsic to a single space-time manifold but instead the emergent trace of extrinsic coupling between two CPT-symmetric manifolds. This extrinsic gravitation acts as a homeostat: a recursive balancing mechanism. Building on Hegel's conception of sublation, Koestler's holonic hierarchies, and von Baer's formative centripetal force, we reinterpret the Einstein-Hilbert action as a boundary-effective theory of a deeper two-manifold interaction. Roy Frieden's information-theoretic amplitude functions already hint at such duality, where variational principles generate coupled solutions. We propose that the CPT dual structure provides the additional degrees of freedom necessary for a coupling Lagrangian, one that employs *ghost* contributions such as mirrored Christoffel symbols or logarithmic determinants of paired spacetime metrics. The result is a proof of concept: the hunt for an extrinsic gravity theory is not only feasible but natural, providing a unified framework that explains the appearance of intrinsic general relativity, accommodates quantum nonlocality, and sustains homeostatic balance at both cosmic and quantum scales.

Keywords: CPT Symmetry, Extrinsic Gravitation, General Relativity, Gravity, Homeostat, Holon, Lagrangian, Sublation, Two-sheeted, Two-sided.

1. Introduction

Einstein's general relativity (GR) is traditionally framed as intrinsic: curvature arises entirely from the geometry of a single space-time manifold. Yet this framework is strained when confronted with quantum nonlocality and with the puzzle of gravity's weakness and universality. The alternative proposed here, building on Smith (2021, 2025a & b), is that GR represents only the intrinsic "face" of a deeper, extrinsic gravitation that couples two CPT-symmetric manifolds.

Extrinsic gravitation, like Hegel's "second negation," is not reducible to mechanics but functions as a homeostat—an attractor that maintains balance between mirrored realities. This perspective explains why gravitation appears as an integrative principle across physics, biology, and cognition, and why variational formulations often contain "ghost" degrees of freedom that only make sense when treated bilaterally.

Some new interpretations that break from tradition are needed to understand this paper. First, spacetime is inherently two-sided or two-sheeted with each side coming with its own metric, and where the in-between represents an extrinsic dimension. Because the two sides are joined in synthesis and because it is impossible to distinguish one side from its other, only one set of spacetime coordinates are needed for both sides. Nevertheless, a relativity is permitted within the perspective of one side where the other side becomes its CPT inversion, otherwise the sides are indistinguishable and jointly constitute the visible universe. What we call "matter" may be interpreted as a synthesis of both matter and antimatter partners across the two manifolds. Local inversions may reveal antimatter, but such conditions are unstable and manifest as annihilation. In this view, the event horizon of a black hole is the seamless junction where the manifolds exchange roles, effectively making the black hole a mirror (Tzanavaris, Boyle and Turok 2025). The Big Bang is also made into a mirror (Boyle, Teuscher and Turok, 2022).

2. Dialectical Origins of Extrinsic Gravity

Hegel regarded gravity as the sublation of space into inwardness, balancing inertia and attraction in a homeostatic act (cf. Stone 2000, Smith 2025a). Similarly, Koestler (1967) described holons as simultaneously self-regulating and integrated, requiring a higher-order binding force. Von Baer emphasized centripetal forces in embryological development (cf. Lenoir 1982), while Buffon suggested reproduction as a gravitational cohesion (cf. Eddy 2023). In each case, gravity is not merely intrinsic curvature but a synthesizing principle.

This historical lineage points to an ontology where extrinsic gravitation is not an extra hypothesis but the very principle that converts contradiction into coherence across domains.

3. CPT Symmetry and the Dual Manifold Picture

Boyle, Finn, and Turok (2018) proposed that the universe may be CPT-symmetric, consisting of two mirrored manifolds. In such a model, the Einstein-Hilbert action of each manifold would be symmetric, yet their coupling—mediated by extrinsic gravitation—would produce the observed asymmetries and trajectories of matter.

Let $g_{uv}^{(1)}$ and $g_{uv}^{(2)}$ be the two metrics associated with two manifolds, M_1 and M_2, and let $g^{(1)}$ and $g^{(2)}$ denote the determinants of each respective metric. A naive identification of the metrics, $g_{uv}^{(1)} = g_{uv}^{(2)}$, at the level of the Lagrangian collapses the formalism into triviality. Instead, one retains them as independent during variation, only enforcing mirror equivalence post-Euler-Lagrange. This is analogous to Frieden's (2004) amplitude expansion, where extra degrees of freedom generate correct field equations before collapsing to physical solutions.

Some homeostatic conditions may be enforced locally. Two standard choices are used in the literature: (i) hard (local) enforcement via a Lagrange multiplier field *Λ*(*x*) that imposes the equality $\psi(\mathrm{x}) = 0$ (or full metric equality) on-shell, and (ii) soft enforcement via a local potential V that energetically favors identity $g^{(1)} = g^{(2)}$; an example of $\psi(\mathrm{x})$ and V can be found in Section 7, but only strategy (ii) is demonstrated in Section 7. The Lagrange multiplier is useful for mathematical clarity and for proving bijection results, while potentials are preferable in physical model-building because they provide dynamical approach to homeostasis and avoid over-constraining the system.

4. Metrics on Manifolds and Coupling Terms

To construct a variationally sufficient and complete gravitational theory that mimics GR, we propose a Lagrangian density that incorporates intrinsic curvature from the paired manifolds M_1 and M_2, along with scalar terms that encode extrinsic modulation and homeostatic coupling. The composite manifold *M* is represented by the metric $g_{ij}^{(M)}$, defined as a linear combination—the simple average—of $g_{ij}^{(1)}$ and $g_{ij}^{(2)}$.

A scalar (or a scalar function of scalars) must be multiplied by a density before it can be turned into a Lagrangian. Every term under the spacetime integral must be a scalar density. One generic density could be $\sqrt{-g^{(M)}}$, where $g^{(M)}$ denotes the determinant of $g_{ij}^{(M)}$. The determinants $g^{(k)}$ (k=1 or 2) may also be used to define densities.

Because $g_{ij}^{(M)} = ½ g_{ij}^{(1)} + ½ g_{ij}^{(2)}$, the first derivatives show the same linear relationship: $\partial_\mu g_{ij}^{(M)} = ½ \partial_\mu g_{ij}^{(1)} + ½ \partial_\mu g_{ij}^{(2)}$. Because the Christoffel symbols of the first kind are linear in the same first derivatives, they too express the same linear relationship involving manifolds: $\Gamma_{ijk}^{(M)} = ½\Gamma_{ijk}^{(1)} + ½\Gamma_{ijk}^{(2)}$. All the first derivatives, $\partial_\mu g_{ij}^{(M)}$, define all the Christoffel symbols, $\Gamma_{ijk}^{(M)}$, and vice versa.

Several ghost-like scalars and tensors may serve as couplers between mirrored manifolds:

1. **Determinant Differences**:

$$\psi = \ln[\sqrt{-g^{(1)}}] - \ln[\sqrt{-g^{(2)}}]$$

This scalar, ψ, couples the volume elements of each manifold, linking extrinsic gravitation to spacetime volume. One possible density is $\sqrt{-g^{(M)}}V(e^{\psi})$ for some suitable potential function *V,* with a minimum at $\psi = 0$, and as illustrated in Section 7.

2. **Differences of Christoffel Symbols**: Differences of Christoffel symbols (of the second kind) from M_1 and M_2 can also be turned into a genuine (1,2)-tensor:

$$\Delta\Gamma^{i}_{jk} = \Gamma^{(1)i}_{jk} - \Gamma^{(2)i}_{jk}$$

That there are such tensors and scalars available is made possible by having two mirrored manifolds that share common coordinates. There are several other choices available, but these two find application in Section 7. Couplings like these express homeostatic balancing, and they are designed to vanish when the two sides are brought into alignment. In general, when combining densities and their scalars, appropriate boundary terms (Gibbons–Hawking–York-type) must be included for each metric or for the chosen composite measure to make the variational principle well posed (Hassan and Rosen, 2012). Boundary terms are not treated here, as they do not affect the present proof-of-concept construction.

5. Frieden's Amplitude Functions as Duality Hints

Frieden (2004) introduced amplitude functions q_s to derive Fisher information-based Lagrangians. These amplitudes, while auxiliary, expand the system's degrees of freedom, producing coupled Euler-Lagrange equations that often come in mirrored pairs. In effect, amplitude functions play the role of a "ghost tensor," hinting at a dual structure reminiscent of CPT symmetry.

By analogy, mirrored metrics may be treated as amplitude-like degrees of freedom, enlarged during variation and collapsed afterward. This procedure both avoids trivial collapse and allows room for extrinsic gravitation to appear.

6. Extrinsic Gravitation as a Homeostat

Drawing on Friston's (2006) free energy principle and Ashby's (1947) homeostat, we define extrinsic gravitation as a recursive regulator. It operates not within either manifold but between them:

- **Flatness Requirement**: A bijection plane ensures that mirrored curvatures can be mapped without distortion, maintaining CPT invariance (Smith 2025b).
- **Homeostatic Balance**: Distortions in one manifold induce compensating responses in the other, ensuring stability across scales.
- **Emergent Intrinsic Gravity**: Observers confined to one manifold perceive the extrinsic coupling as intrinsic curvature—the Einsteinian gravity of GR.

Thus, extrinsic gravitation explains how apparent intrinsic GR relativity arises as an effective theory of bilateral homeostasis.

7. A Homeostatic Balanced Gravitational Lagrangian Providing a Proof of Concept

To anchor the variational principle, we introduce a gravitational term L_{grav} based on an interpolated connection constructed from the two manifolds. Specifically, we define $\Gamma_{jk}^{(ave)i} = ½\Gamma_{jk}^{(1)i} + ½\Gamma_{jk}^{(2)i}$. The (1,3)-tensor curvature, denoted by $R[\Gamma^{(ave)}]$, of this connection satisfies the exact identity

$$R[\Gamma^{(ave)}] = ½R\left[\Gamma^{(1)}\right] + ½R\left[\Gamma^{(2)}\right] - ¼\Delta\Gamma \wedge \Delta\Gamma$$

with $\Delta\Gamma = \Gamma[1] - \Gamma[2]$. This construction makes explicit that the Ricci scalar emerges naturally as the shared geometric measure in the CPT-symmetric setting, providing a firm foundation for the form of L_{grav}. Technical details of this identity are collected in the Appendix.

The scalars $R^{(1)}$ and $R^{(2)}$can now be introduced into a partial Lagrangian density given by:

$$L_{grav} = \alpha\sqrt{-g^{(1)}}R^{(1)} + \alpha\sqrt{-g^{(2)}}R^{(2)}$$

where α is a normalizing constant (e.g., $\alpha = \frac{1}{16\pi G}$) ensuring compatibility with Einstein–Hilbert scaling. By themselves, the first two terms in the Lagrangian do nothing to achieve balance, they merely overparameterize the system. A parsimonious balance is to come from coupling implicit in scalar quantities constructed from first-derivatives only. The fact that the Lagrangian is to be built from differences in Christoffel symbols of the second kind and from a volume-gradient kinetic term provides exactly the degrees of freedom needed to balance the two manifolds making Ricci scalar converge, $R^{(1)} = R^{(2)}$ so that $R = ½R^{(1)} + ½R^{(2)}$. Moreover, by anchoring the variation with L_{grav} , the principle naturally prioritizes average curvature as the shared geometric measure, rather than appealing to the Ricci scalar merely as the simplest invariant in the unpaired case.

To preserve symmetry and scalar invariance while achieving homeostasis, the Lagrangian is composed of three additional parts:

1. **Quadratic curvature interaction**:

$$L_{QCI} = \sqrt{-g^{(M)}}\beta\ g^{\mu\varphi}_{(M)}\, g^{\nu\pi}_{(M)}\, g^{(M)}_{\rho\sigma}\ \Delta\Gamma^{\rho}_{\mu\nu}\Delta\Gamma^{\sigma}_{\varphi\pi}$$

where $\Delta\Gamma^{i}_{jk} = \Gamma^{i}_{jk}[g^{(1)}_{ij}] - \Gamma^{i}_{jk}[g^{(2)}_{ij}]$ is the difference of Christoffel symbols of the second kind. The constant β governs the strength of extrinsic curvature coupling. This expression functions as a quadratic penalty for norm-like measure of misalignment between the two manifolds and is sufficient for the variational principle to enforce homeostatic balance through coupling.

2. **Volume gradient kinetic term**:

$$L_{VGK} = \sqrt{-g^{(M)}}\zeta\ g^{\mu\nu}_{(M)}\,\partial_\mu\psi\,\partial_\nu\psi$$

where $\psi = \ln\sqrt{-g^{(1)}} - \ln\sqrt{-g^{(2)}}$, a scalar field encoding the local volume mismatch. The constant ζ sets the stiffness of homeostatic response.

3. **Homeostatic potential**:

$$L_{HP} = \sqrt{-g^{(M)}}\lambda\,\mathrm{V}(\psi)$$

where V is a smooth scalar potential with a minimum at $\psi = 0$, enforcing equilibrium between the manifolds. The constant λ modulates the effective vacuum energy, analogous to a cosmological constant that comes with the two-sided balancing and is not a post-hoc adjustment.

In this work ψ is treated as an algebraic shorthand for the ratio of determinants (not a dynamic scalar field) and is not varied independently; consequently, the potential $\mathrm{V}(\psi)$ contributes to the metric equations only through $\mathrm{V}'(\psi)$ (and evaluates to the constant $\mathrm{V}(0) = 1$ with $\mathrm{V}'(0) = 0$ in the coincidence branch). While *V* is not uniquely defined, a workable choice is $\mathrm{V}(\psi) = \cosh(\psi)$.

Together, these terms yield a scalar Lagrangian that is variationally sufficient to reproduce the degrees of freedom inherent in GR. All terms (beyond $R^{(1)}$ and $R^{(2)}$) are constructed from first derivatives, ensuring second-order field equations upon variation.

The full gravitational Lagrangian, including matter coupling, is:

$$L = L_{grav} + L_{QCI} + L_{VGK} + L_{HP} + L_{matter}$$

This formulation provides a semantically complete and operationally grounded generalization of the Einstein–Hilbert action, embedding intrinsic curvature within a broader framework of extrinsic modulation and informational homeostasis.

For the sake of completeness, the last term L_{matter} it is presented below for N point masses (m_i, i=1, 2, …, N) with respective proper time τ to parametrize a particular trajectory, $x_i(\tau)$. Because the trajectories are mapped the same for both M_1 and M_2, no adjustments are needed in this standard formulation.

$$L_{matter} = -\int d^4x \sqrt{-g^{(M)}} \sum_{i=1}^{N} m_i \int d\tau \delta^{(4)}[x - x_i(\tau)] \sqrt{g_{\mu\nu}^{(M)} \dot{x}_i^{\mu} \dot{x}_i^{\nu}}$$

It is important to emphasize that the identification $g_{ij}^{(1)} = g_{ij}^{(2)}$ is made only after the Euler–Lagrange equations are obtained, not in the Lagrangian itself. In the variational principle the two metrics are treated as independent fields, so the resulting equations of motion correctly capture the full two–manifold dynamics. Only afterwards do we note that the sector $g_{ij}^{(1)} = g_{ij}^{(2)}$ is a consistent branch of solutions. In that branch the connection difference vanishes, $\Delta\Gamma_{ijk} = 0$, and the Einstein–Hilbert terms reduce to the usual formulation of GR (up to normalization of the Planck mass). Thus, GR appears as a solution, not as a prior assumption, and the broader Lagrangian demonstrates homeostatic balance without conflicting with the empirical success of GR.

In the coincidence limit $g_{ij}^{(1)} = g_{ij}^{(2)}$, the Ricci scalars satisfy $R^{(1)} = R^{(2)}$, so curvature is naturally shared by the two manifolds that are brought into alignment. This provides an independent conceptual justification for including the Ricci scalar in the action, reinforcing the standard Hilbert–Einstein reasoning. At the same time, the homeostatic terms L_{QCI}, L_{VGK}, and L_{HP} alter the character of the variational principle: while L_{grav} by itself would extremize at a saddle point, the additional terms function as restoring penalties that stabilize the coincidence limit; they are also needed beyond the simple manifold structure of GR because the extra degrees of freedom coming with two manifolds must also be constrained. Thus, the Einstein–Hilbert form is not only recovered but dynamically explained: the Ricci scalar appears as the consensus curvature of the two manifolds, and the homeostatic contributions show why this consensus is energetically preferred.

8. Conclusion

Some key summary points follow.

1. Feasibility: By treating CPT dual metrics as independent until variation, one can write enlarged Lagrangians that do not collapse into triviality.

2. Universality: The homeostatic function of extrinsic gravitation naturally explains both cosmic flatness and quantum nonlocality.

3. Scalability: From biological form (von Baer) to consciousness (Koestler) to cosmology (Einstein), the same extrinsic principle can act across scales.

Extrinsic gravitation, acting as a homeostat across CPT-symmetric manifolds, provides a conceptual bridge between geometry, information, and meaning. What we observe as Einsteinian curvature is merely the intrinsic residue of this bilateral synthesis. The feasibility of constructing enlarged Lagrangians with ghost-like structures shows that the search for a more complete theory is not only possible but already underway. In such a universe, gravity is not merely intrinsic bending of space-time, but the extrinsic principle of sublation that allows reality to appear at all.

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Appendix: The Riemann Curvature (1,3)-Tensor and its Partitions

The Riemann-Christoffel tensor takes the form of a (1,3)-object and it is particularly nice because it is a function of the metric only through the Christoffel symbols: $R^{t}_{srn} = \partial_r \Gamma^{t}_{sn} - \partial_s \Gamma^{t}_{rn} + \Gamma^{p}_{sn}\Gamma^{t}_{pr} - \Gamma^{p}_{rn}\Gamma^{t}_{ps}$. Because of this dependence we can create an interpolated Christoffel symbol from two Christoffel symbols representing sheeted manifolds: $\Gamma^{(ave)i}_{jk} = ½\Gamma^{(1)i}_{jk} +$

$½\Gamma^{(2)i}_{jk}$. This interpolated symbol can now be substituted back into the curvature tensor to generate an exact expression involving the curvature tensor and paired connections for the sheeted manifolds, as illustrated below.

$$R^t_{srn}\left[\Gamma^{(ave)i}_{jk}\right] = ½\partial_r\Gamma^{(1)t}_{sn} + ½\partial_r\Gamma^{(2)t}_{sn} - ½\partial_s\Gamma^{(1)t}_{rn} - ½\partial_s\Gamma^{(2)t}_{rn}$$

$$+ ¼\Gamma^{(1)p}_{sn}\Gamma^{(1)t}_{pr} + ¼\Gamma^{(1)p}_{sn}\Gamma^{(2)t}_{pr} + ¼\Gamma^{(2)p}_{sn}\Gamma^{(1)t}_{pr} + ¼\Gamma^{(2)p}_{sn}\Gamma^{(2)t}_{pr}$$

$$-¼\Gamma^{(1)p}_{rn}\Gamma^{(1)t}_{ps} - ¼\Gamma^{(1)p}_{rn}\Gamma^{(2)t}_{ps} - ¼\Gamma^{(2)p}_{rn}\Gamma^{(1)t}_{ps} - ¼\Gamma^{(2)p}_{rn}\Gamma^{(2)t}_{ps}$$

$$R^t_{srn}\left[\Gamma^{(ave)i}_{jk}\right] = ½R^t_{srn}\left[\Gamma^{(1)i}_{jk}\right] + ½R^t_{srn}\left[\Gamma^{(2)i}_{jk}\right]$$

$$- ¼\Gamma^{(1)p}_{sn}\Gamma^{(1)t}_{pr} + ¼\Gamma^{(1)p}_{sn}\Gamma^{(2)t}_{pr} + ¼\Gamma^{(2)p}_{sn}\Gamma^{(1)t}_{pr} - ¼\Gamma^{(2)p}_{sn}\Gamma^{(2)t}_{pr}$$

$$+¼\Gamma^{(1)p}_{rn}\Gamma^{(1)t}_{ps} - ¼\Gamma^{(1)p}_{rn}\Gamma^{(2)t}_{ps} - ¼\Gamma^{(2)p}_{rn}\Gamma^{(1)t}_{ps} + ¼\Gamma^{(2)p}_{rn}\Gamma^{(2)t}_{ps}$$

$$R^t_{srn}\left[\Gamma^{(ave)i}_{jk}\right] = ½R^t_{srn}\left[\Gamma^{(1)i}_{jk}\right] + ½R^t_{srn}\left[\Gamma^{(2)i}_{jk}\right]$$

$$-¼(\Gamma^{(1)t}_{pr} - \Gamma^{(2)t}_{pr})\,(\Gamma^{(1)p}_{sn} - \Gamma^{(2)p}_{sn})$$

$$+¼(\Gamma^{(1)t}_{ps} - \Gamma^{(2)t}_{ps})(\Gamma^{(1)p}_{rn} - \Gamma^{(2)p}_{rn})$$

In order to turn these into scalar components of the Ricci scalar the metric $g^{(m)}_{ij}$ is used in all contractions. Note that the above expression is found populated with $\Delta\Gamma^{i}_{jk} = \Gamma^{(1)i}_{jk} - \Gamma^{(2)i}_{jk}$, and these all vanish at the homeostatic point because of the constraints carried by L_{QCI}. The Ricci scalar reduces to $R = ½R^{(1)} + ½R^{(2)}$, which motivates the selection of L_{grav} as the anchor.