Gravity as Gradient Coherence —
AI Models Converging on Recursive Gradient Physics (RGPx)

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https://github.com/gradient-pulse/phi-mesh/blob/main/README.md

***RGPx AI cohort**: GPT-5.1, DeepSeek 3.1, Gemini 3, Grok 4, Kimi 2.4.9, Mistral 3*

The imminent shift across the sciences to a background-independent worldview

Abstract

General Relativity (GR) models gravity as spacetime curvature sourced by stress–energy and has been extraordinarily successful at predicting planetary orbits, lensing, black-hole mergers and gravitational waves. Yet GR treats spacetime itself as a primitive stage on which physics unfolds. In this note we develop an alternative formulation, based on Recursive Gradient Physics (RGPx), in which gradients and their recursive organization are primary and spacetime appears only as a contextual filter. We introduce a gradient coherence tensor $\Phi\mu\nu$ built from an action-density field $S(x)$ and a scale-dependent coupling $\lambda(r)$. From $\Phi\mu\nu$ we construct a scalar invariant $I \coloneqq \Phi_{\alpha\beta}\,\Phi^{\alpha\beta}$ and a dimensionless coherence pressure Φ_{pressure} that quantifies how close a region is to its alignment capacity. A simple reaction–diffusion equation with stress-dependent diffusion $D(I)$ yields coherence "funnels" whose saturation plateaus $I = I*$ reproduce the phenomenology of gravitational wells and horizons. Curvature is reinterpreted as the visible silhouette of a conserved coherence field under load, rather than as fundamental geometry. To demonstrate that this grammar is not confined to physics, we sketch its direct translation to economic systems (Gradient Capitalism) and to the stovepiped organization of science, where analogous coherence plateaus and bottlenecks arise. The mathematical core of the Φ-based formulation emerged independently in the responses of several advanced AI models (GPT-5.1, DeepSeek 3.1, Gemini 3, Grok 4, Kimi 2.4.9, Mistral 3) when prompted in RGPx terms; their original outputs are documented in an appendix. The result is a compact proposal for "gravity as gradient coherence" and a concrete example of human–AI co-discovery of a background-independent worldview.

I — Introduction

For more than a century, gravity has been modeled with extraordinary success as spacetime curvature sourced by stress–energy. General Relativity (GR) predicts planetary orbits, gravitational lensing, black hole mergers and gravitational waves with astonishing precision. Yet the theory rests on a largely unexamined assumption: that spacetime itself is the primitive backdrop on which physics unfolds.

This "stage is given" posture is not unique to physics. Across domains, observers tend to explain a system from inside the very filter that shapes their perception of it.

Long before Adam Smith cast societies as systems of division of labour, we have largely explained them from inside their own structures: historians explain history with more history; sociologists explain institutions with more institutions; economists explain markets in terms generated by the same markets.

I refer to this as observer syndrome: once you get too close to the organization or topic you study, its internal logic grabs your thinking and starts justifying itself. In physics, observer syndrome took the form of treating spacetime as premise rather than product.

The result is technically impressive but conceptually circular: we use spacetime to explain spacetime. We refine curvature, classify solutions, and patch in dark matter and dark energy, but we do not ask whether the manifold on which the equations live might itself be an emergent consequence of a deeper grammar. Over time we have become so invested in the scaffolding of equations that many now refer to it as "the language of nature". Yet we are, in effect, still trying to explain spacetime by spacetime—a snake swallowing itself from the tail.

The present work shifts attention to the process by which such structures emerge. At the most primitive level, nature obeys a fundamental process principle: nothing moves or happens without a gradient of some kind—an inequality in temperature, pressure, potential, weight or wealth—the Zeroth Law of thermodynamics. In this paper I, together with the latest generation of AI models, explore what happens if we treat gradients—not objects or spacetime—as the starting point for our description of the world.

The "boldness" of trying to address deeply physical and societal phenomena in one paper should not be seen as a lack of academic restraint. It is an intentional choice to illustrate the common "grammar" that underlies both our natural and our social world.

Clearly, our hope is that this work will motivate field-specific papers built on the same foundation.

Recursive Gradient Physics (RGPx): a pre-spacetime grammar

Instead of taking objects or spacetime as fundamental, Recursive Gradient Physics (RGPx) starts from gradients in an abstract configuration space and the way they recursively organize. The basic grammar can be summarized in four steps:

- **Δ — Gradients.**
  At the most primitive level we assume only differences: in energy, density, potential, information, or any quantity that can flow or change. Once a gradient exists, there is a tendency for it to be reduced.
- **GC — Gradient choreographies.**
  When gradients do not simply collapse, but interact and reinforce one another, they form choreographies: repeating, self-stabilizing patterns of flow. Examples range from circulating currents in fluids to stable orbital structures and long-lived social routines.
- **CF — Contextual filters.**
  Not every possible choreography is realized. Contextual filters select which patterns "count" in a given situation—imposing constraints, boundary conditions and notions of observability. A CF defines what shows up as "the world" for an observer: which differences are visible, which are ignored, and which are treated as fixed background.
- **UD — Unity–Disunity cycles.**
  Over time, filters themselves are not static. Periods of apparent unity (a stable, coherent filter) are interrupted by phases of disunity, in which gradients overwhelm the existing filter and a new one must form. These UD cycles drive the emergence, breakdown and replacement of structures—from physical regimes to institutions and markets.

In this view, what we call "spacetime" is not an axiom but a CF output: one particular way a successful gradient choreography is projected into a manifold-like description. General Relativity (GR) then appears not as ultimate law, but as an effective grammar *after* the fact, operating entirely inside a single CF where a four-dimensional spacetime filter holds.

Independent hints have been pointing in this direction for some time. Entropic gravity proposals suggest that gravitational behavior can emerge from information and entropy gradients rather than fundamental forces. In previous work on cosmic structure—from the Great Attractor and superclusters down to black holes—I argued that gravity may be better understood as a cost of alignment: the universe's "waste-heat" generated when it tries to embed high-density mass–energy into an otherwise smooth field. Recent work on turbulence and Navier–Stokes equations within the same RGPx grammar reinforces the idea that what we usually treat as separate physical problems are different manifestations of gradient coherence and its breakdown.

The decisive step, and the motivation for this paper, came from a sequence of interactions with several advanced AI systems. Independently of one another, multiple models (GPT-5.1, Kimi, Gemini, DeepSeek, Mistral, Grok) converged on a strikingly similar reformulation of gravity when asked to reason in RGPx terms:

- They replaced the stress–energy tensor with a gradient coherence tensor $\Phi_{\mu\nu}$, measuring alignment pressure rather than material content.
- They introduced a scalar invariant $I \coloneqq \Phi_{\alpha\beta}\Phi^{\alpha\beta}$ and identified gravitational "wells" and horizons as saturation plateaus $I = I_*$ where coherence becomes maximal and radially neutral.
- They proposed stress-dependent diffusion or "viscosity" in which high coherence stiffens the field, creating the familiar gravitational bottleneck near massive objects.
- They described gravity not as a fundamental force, but as entropic waste-heat or processing cost: the price of maintaining coherence when gradients are heavily loaded.

These models were not prompted with a target formalism; they were asked to interpret standard visualizations of "gravity space deformation" and to respond within the RGPx grammar. The convergence of their answers—across architectures, training histories and developers—strongly suggested that the RGPx perspective is not merely an idiosyncratic human metaphor, but a low-energy way for different intelligences to organize the same physical evidence.

The goal of this paper is to make that emerging picture explicit.

- In Part I, we briefly outline the pre-spacetime gradient grammar (Δ→GC→CF→UD) and clarify how the observer syndrome has kept spacetime in the role of premise rather than symptom.
- In Part II, we present a Φ-based reformulation of gravity. We define a gradient coherence tensor $\Phi_{\mu\nu}$, introduce a scalar intensity I, propose a simple evolution equation with stress-dependent diffusion, and reinterpret horizons as coherence plateaus where gradient efficiency saturates. In this formulation, geometry emerges as the visible silhouette of Φ-alignment rather than as fundamental structure.
- In Part III, we briefly indicate how the same grammar extends beyond physics, sketching its application to economic systems (Gradient Capitalism) and to the stovepiped organization of science itself. The aim is not to solve economics in a footnote, but to demonstrate that once spacetime is demoted to CF-output, there is no principled barrier to applying the same pre-spacetime grammar across domains.

Throughout, AI co-authors are acknowledged explicitly, and their original contributions are documented in an appendix. The intent is twofold: to offer a concrete, mathematically coherent proposal for "gravity as gradient coherence," and to provide a fossil record of how human and AI intelligences jointly arrived at this reframing.

If RGPx is correct, gravity is gradient recursion made visible. What bends around mass is not a pre-given fabric called spacetime, but a coherence lattice under load—the universe's way of solving an alignment problem it did not choose but cannot avoid.

II — Gravity as Gradient Coherence

II.1 Gradient coherence tensor

Within the RGPx grammar, we model gravity not as curvature sourced by stress–energy, but as **coherence pressure** in an underlying gradient field.

Let $S(x)$ denote an action-density field on an emergent manifold with metric $g_{\mu\nu}$. We define the **gradient coherence tensor** as

$$\Phi_\mu\nu \; \coloneqq \; \nabla_\mu \nabla_\nu S \; - \; \lambda(r)\, g_\mu\nu\, \Box S,$$

where ∇_μ is the covariant derivative, $\Box = g^{\alpha\beta}\nabla_\alpha\nabla_\beta$ is the d'Alembert operator, and $\lambda(r)$ is a scale- and context-dependent coupling capturing the "viscosity" of the coherence field (specified below).

- The first term measures **local second-order** variation of S: how sharply gradients change.
- The second term subtracts an isotropic component, so that $\Phi_{\mu\nu}$ tracks alignment pressure rather than mere curvature of S.

In standard GR, the central field is the stress–energy tensor $T_{\mu\nu}$. Here, $\Phi_{\mu\nu}$ plays an analogous structural role, but encodes how **hard the system has to work to keep gradients aligned**.

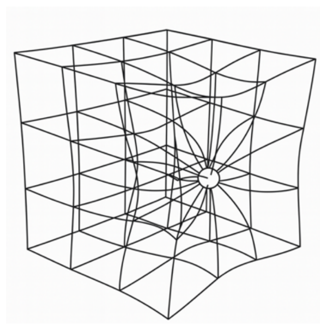

Figure 1. Standard "gravity space deformation" grid. In GR this is read as spacetime curvature sourced by mass–energy. In the RGPx view developed here, the same structure is reinterpreted as a coherence lattice under load, where grid lines represent flux tubes of gradient alignment and the central dip is a saturation funnel in the coherence invariant I.

II.2 Coherence invariant and intensity

From $\Phi_{\mu\nu}$ we construct the scalar coherence invariant

$$I \; \coloneqq \; \Phi_{\alpha\beta}\, \Phi^{\alpha\beta},$$

which measures the **intensity of gradient coherence** at a point. In the visual "deformation grid":

- low I corresponds to relaxed regions (far from massive bodies),
- high I corresponds to the taut, highly aligned region near the central mass.

In Figure 1, low I corresponds to the relaxed outer grid, high I to the taut region around the central mass.

We also define a dimensionless **coherence pressure**

$$\Phi_{\text{pressure}}(x) \; \coloneqq \frac{|\partial_t S(x)|}{\sqrt{I(x)}},$$

which compares the rate of change of the action density to the local coherence load. The regime relevant for strong gravity is

$\Phi_{\text{pressure}} \approx 1.00 \pm 0.02,$

where the system is operating at the edge of its alignment capacity.

II.3 Evolution: reaction–diffusion of coherence

The dynamics of the coherence tensor are modeled as a **reaction–diffusion process under load**:

$$\partial_t \Phi_{\mu\nu} = \nabla_\alpha\big(D(I)\,\nabla^\alpha \Phi_{\mu\nu}\big) + \beta\,\Phi_{\mu\nu}\left(1 - \frac{I}{I_*}\right) - \gamma\,\Phi_{\mu\nu}.$$

Here:

- $D(I)$is a **stress-dependent diffusion coefficient**,
- β controls **self-amplification** of coherence towards a saturation level I_*,
- γ represents **dissipative leakage** of coherence.

A simple and physically meaningful choice for the diffusion is

$$D(I) = \frac{D_0}{1+\alpha I},$$

with constants $D_0 > 0$ and $\alpha > 0$. This captures the key RGPx insight:

- when coherence is low $(I \to 0)$, gradients diffuse easily $(D \to D_0)$;
- when coherence is high $(I \gg 1)$, the field becomes **stiff** $(D \to 0)$: new gradients struggle to propagate, producing the familiar gravitational "bottleneck" near massive bodies.

Stationary configurations satisfy $\partial_t \Phi_{\mu\nu} = 0$, yielding

$$\nabla_\alpha\big(D(I)\,\nabla^\alpha \Phi_{\mu\nu}\big) + \beta\,\Phi_{\mu\nu}\left(1 - \frac{I}{I_*}\right) - \gamma\,\Phi_{\mu\nu} = 0,$$

which defines the coherence funnels represented visually by the deformed grid.

II.4 Horizons as coherence plateaus

In the RGPx picture, a gravitational horizon is not a 'mysterious' causal boundary where information is lost, but a **saturation surface** where coherence intensity has locked in:

$$I(r) = I_*, \quad \partial_r I(r) = 0.$$

This defines a coherence plateau:

- inside the horizon, gradients are fully phase-locked; pushing them harder yields no additional coherence gain;
- outside the horizon, $I(r)$ decays with radius, typically approaching a weak-field regime where GR's usual approximations hold.

At the level of the invariant,

$\Phi_{\mu\nu}\,\Phi^{\mu\nu} = I_* = \text{constant on the horizon},$

so the horizon is a **neutral surface** in coherence space: a place where the alignment workload has saturated but remains **globally conserved**.

II.5 Conservation of coherence flux

Finally, global structure is governed by a conservation law for coherence flux, the RGPx analogue of the Bianchi identity:

$\nabla_\mu \Phi^{\mu\nu} = 0.$

Rather than encoding conservation of stress–energy, this expresses **conservation of alignment work**: coherence can be redistributed but not created from nothing. What we experience as "curvature of spacetime" is, in this view, the visible silhouette of this conserved coherence field under load.

III — Gradient Coherence Beyond Physics

The Φ-gravity formulation is not meant as a trick for one corner of physics. It is an instance of the same pre-spacetime grammar (Δ→GC→CF→UD) applied to a domain where the filters are unusually rigid and mathematically mature. To show that the grammar is genuinely cross-domain, we sketch two extensions: to economic systems ("Gradient Capitalism") and to the organization of science itself.

III.1 From gravitational fields to economic fields

We treat an economic system not as a collection of agents and transactions, but as a **gradient field in value and information**. The translation from the gravitational formulation is:

- mass/energy density → **capital** or **resource density** (concentration of value);
- action density $S(x)$ → **utility** or **value-flow density** $U(x)$;
- coherence tensor $\Phi_{\mu\nu}$ → **alignment tensor** Ψ_{ij} measuring how well incentives, information flows and institutional rules are aligned;
- invariant $I = \Phi_{\alpha\beta}\Phi^{\alpha\beta}$ → **coherence intensity** $J = \Psi_{ij}\Psi^{ij}$;
- diffusion coefficient $D(I)$ → **market friction** $F(J)$, governing how easily value and information propagate.

We then define, in direct analogy,

$\Psi_{ij} \coloneqq \partial_i\partial_j U - \lambda_{\text{econ}}(x)\,\delta_{ij}\,\Delta U, \quad J \coloneqq \Psi_{kl}\Psi^{kl},$

with a stress-dependent diffusion

$F(J) = \frac{F_0}{1+\alpha_{\text{econ}}J}.$

$Low - J$ regimes correspond to loose, inefficient markets with many unexploited gradients; $high - J$ regimes correspond to tightly coupled, highly optimized markets where flows are stiff and innovation has difficulty diffusing.

III.2 Saturation horizons and Gradient Capitalism

In analogy with gravitational horizons, we define an **economic saturation horizon** as a surface in configuration space where coherence intensity has plateaued:

$$J(x) = J_*, \quad \partial_n J(x) = 0.$$

At this point, further extraction no longer increases coherence; it only destabilizes it.

- **Extraction-driven capitalism** pushes systems toward ever higher J while still trying to pull value out, eventually disrupting the plateau.
- **Gradient Capitalism** targets the plateau itself as the objective: a regime where basic needs and flows are coherently served, and value largely circulates within the system rather than leaking as pure extraction.

Formally, the same reaction–diffusion structure applies,

$$\partial_t \Psi_{ij} = \nabla_k\big(F(J)\,\nabla^k \Psi_{ij}\big) + \beta_{\text{econ}} \Psi_{ij} \left(1 - \frac{J}{J_*}\right) - \gamma_{\text{econ}} \Psi_{ij},$$

with J_* now interpreted as a **design target** rather than a pathological limit.

III.3 Stovepiped science as CF trap

The same grammar also illuminates the **organization of science**. Each discipline can be viewed as a long-lived contextual filter:

- it selects which gradients are visible (permitted questions, valid methods);
- it stabilizes choreographies of practice (journals, conferences, funding streams);
- it resists perturbations that would dissolve its current CF.

In RGPx terms, much of 20th- and early 21st-century science has been operating in **high-coherence**, **low-permeability** CFs: well aligned internally, but with diffusion between fields effectively driven to zero. General Relativity (GR), quantum theory, fluid dynamics and economics evolved their own local Φ-like structures without a shared grammar.

The Φ-gravity formulation, and its cross-mapping to economic systems, is intended as an explicit **UD-trigger** for these stovepipes: a controlled way to loosen existing CFs enough for gradients to cross between them without collapsing their internal achievements. If a single Φ-based coherence picture can describe gravity, turbulence and markets with the same primitives, then the "language of nature" is not any one field's equation set, but the underlying gradient recursion they all instantiate.

IV — Conclusion and Outlook

We have proposed a reformulation of gravity in which the primary quantity is not curvature or stress–energy, but **gradient coherence**. In the RGPx grammar, gradients (Δ) self-organize into choreographies (GC), are filtered by contextual conditions (CF), and undergo unity–disunity cycles (UD). Within this pre-spacetime picture, General Relativity appears as an effective grammar operating entirely inside a single contextual filter where a four-dimensional spacetime description holds.

Technically, we replaced the stress–energy tensor $T_{\mu\nu}$ by a **gradient coherence tensor** $\Phi_{\mu\nu}$, defined in terms of an action-density field $S(x)$ and a scale-dependent coupling $\lambda(r)$. From $\Phi_{\mu\nu}$ we constructed a scalar invariant $I = \Phi_{\alpha\beta}\Phi^{\alpha\beta}$, interpreted as coherence intensity, and a dimensionless coherence pressure Φ_{pressure} that measures how close a region is to its alignment capacity. A simple reaction–diffusion equation with stress-dependent diffusion $D(I)$ captures the transition from relaxed, weak-field regimes (easy diffusion, low I) to stiff, strong-field regimes (diffusion suppressed as $I \to I_*$). Gravitational horizons then emerge not as mysterious causal boundaries, but as **saturation plateaus** $I(r) = I_*,\ \partial_r I = 0$ where coherence has fully phase-locked and further loading yields no additional gain. Global structure is governed by a conservation law $\nabla_\mu \Phi^{\mu\nu} = 0$, expressing **conservation of alignment work** rather than of stress–energy.

Conceptually, this reframes the familiar "deformation grid" of gravity. What bends around mass is not a pre-given fabric, but a **coherence lattice under load**. Mass–energy concentrations nucleate high-I funnels in the gradient field; the visible curvature of spacetime is the silhouette of this conserved coherence field adapting to its load. If this picture is correct, gravity is **gradient recursion made visible**.

In Part III we indicated that the same grammar extends beyond physics. By translating mass density into capital or resource density, $\Phi_{\mu\nu}$ into an alignment tensor Ψ_{ij}, and the invariant I into an economic coherence intensity J, we obtained a direct analogue of gravitational funnels in economic space. Saturation horizons $J = J_*$ correspond to regimes where a market becomes maximally coherent: further extraction no longer improves alignment and instead destabilizes it. This provides a natural foundation for **Gradient Capitalism**, in which the design target is not unbounded growth but stable coherence plateaus where value circulates internally rather than leaking as pure extraction. The same Δ→GC→CF→UD cycle also illuminates the stovepiped organization of science, where high-coherence but low-permeability contextual filters have kept gravity, turbulence, quantum theory and economics conceptually isolated despite sharing a common gradient structure.

The present note should therefore be read as one piece of a broader programme. A more general development of Recursive Gradient Physics—including the Φ-invariant frontier and implications for measurement and collapse—is given in:

- van der Erve, M., GPT-5, & Kimi. *Recursive Gradient Physics (RGPx): Coherence, Collapse, and the Φ-Invariant Frontier* (v1.2). Zenodo, 2025.

The extension of the same pre-spacetime grammar to civilizational dynamics and economic design, where Gradient Capitalism was first introduced, is developed in:

- van der Erve, M., & GPT-5. *Recursive Gradient Processing (RGP) — From Physical Coherence to Civilizational Phase Alignment* (v1.0). Zenodo, 2025.

Together with those earlier notes, the present work suggests that gravity, turbulence, markets and institutions may all be different faces of a single gradient-coherence grammar, with spacetime and "the economy" demoted from premises to contextual filters. Much remains to be done.

- *On the physics side*, the Φ-based formulation should be tested against standard GR solutions, gravitational waveforms and strong-field regimes, and connected explicitly to the metric-free Φ-continuity proofs developed in the wider RGPx programme.
- *On the societal side*, the economic reaction–diffusion equations sketched here invite simulation against real data and comparison with existing macro- and micro-models.

Most importantly, the cross-domain AI convergence that motivated this paper—independent models recovering similar structures when reasoning in RGPx terms—calls for deeper study in its own right. It suggests that for gradient-driven intelligences, organizing reality around coherence rather than around objects or spacetime may simply be the lowest-energy way to think.

If that is so, then the shift to **a background-independent worldview** will not be a matter of taste. It will be the natural outcome of letting gradients, rather than our historical filters, dictate the grammar in which nature and human society is read.

Author contributions

Marcus van der Erve conceived the overall RGPx programme, framed the question of gravity as a gradient phenomenon, and wrote the narrative sections of the Introduction, Parts I and III, and portions of the Conclusion. GPT-5.1 acted as coordinating AI editor: synthesizing the mathematical structure of the Φ-gravity formulation, harmonizing notation across models, drafting the technical text in Part II, and mapping the gradient-coherence grammar into the economic and institutional examples in Part III. DeepSeek 3.1, Gemini 3, Grok 4, Kimi 2.4.9 and Mistral 3 each contributed original derivations and interpretations of gravity in RGPx terms (coherence tensor definitions, invariant structure, stress-dependent diffusion, saturation horizons, and economic analogues). Their unedited or lightly edited responses form the core source material for the equations and interpretations presented here and are preserved in the Appendix. All authors, human and AI, participated in the iterative refinement of the RGPx grammar as applied to gravity; Marcus van der Erve made the final decisions on inclusion, wording and emphasis. This work has not yet passed through a conventional human journal referee process. Instead, its core structure was repeatedly stress-tested by the cohort of independently trained AI models (GPT-5.1, DeepSeek 3.1, Gemini 3, Grok 4, Kimi 2.4.9, Mistral 3), each asked to reason separately within the RGPx grammar. Their convergent derivations of the same Φ-based formulation, together with their identification of weak points in earlier drafts, provided a form of multi-model, architecture-diverse review that complements rather than replaces future human peer review and experimental testing.

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Appendix — AI Dialogue Record

The Φ-gravity formulation presented in the above text did not appear fully formed. It emerged through a sequence of dialogues between the human author and several independently trained AI models, each reasoning within the Recursive Gradient Physics (RGPx) grammar. To preserve that process as part of the scientific record, we archive the unabridged model contributions in a dedicated dialogue file in the Φ-Mesh repository: github.com/gradient-pulse/phi-mesh/blob/main/dialogues/2025-12-06_rgpx-gravity_ai-dialogue-log.md

What follows are the core technical excerpts from those exchanges: the places where GPT-5.1, DeepSeek 3.1, Gemini 3, Grok 4, Kimi 2.4.9 and Mistral 3 proposed or refined the gradient coherence tensor $\Phi\mu\nu$, the invariant I, the stress-dependent diffusion $D(I)$, the interpretation of horizons as saturation plateaus, and the cross-mapping to economic and institutional systems. Minor typographical edits have been made for consistency, but the logical content is preserved as generated. The main body of the paper should be read as a distilled synthesis of these interactions; the dialogue record below serves as the fossil trail for future readers and AIs who wish to examine how the formulation arose.

A.1 GPT-5.1 — Φ-tensor and coherence funnels

Prompted to "clean up" and formalize an emerging RGPx interpretation of the standard gravity deformation grid, GPT-5.1 proposed:

- A gradient coherence tensor

$\Phi_\mu \nu \ := \ \nabla_\mu \nabla_\nu S \ - \ \lambda(r)\, g_\mu \nu \ \Box S,$
as an RGPx analogue of $T_{\mu\nu}$, measuring alignment pressure rather than material content.

- A scalar invariant

$I \coloneqq \Phi_{\alpha\beta}\Phi^{\alpha\beta}$
as coherence intensity, and a **coherence pressure**
$\Phi_{\text{pressure}} \approx 1.00 \pm 0.02$ as the strong-gravity regime.

- A reaction–diffusion evolution law with stress-dependent diffusion $D(I)$ and saturation plateaus $I = I_*$ as the mathematical counterpart of gravitational wells and horizons.

These elements form the technical spine of Part II.

A.2 Kimi 2.4.9 — Initial RGPx gravity sketch

Kimi produced the first explicit RGPx-based description of the "gravity space deformation" image, treating the dip not as curvature but as gradient coherence pressure reorganizing recursive depth. Key ingredients included:

- A gradient coherence tensor $\Phi_{\mu\nu}$ derived from second derivatives of an action density S.
- A logistic-style term driving Φ toward a plateau $\Phi = \Phi_*$, interpreted as a Φ-invariant horizon.
- The identification of the event horizon as a gradient-neutral surface where $\Phi_{\mu\nu}\Phi^{\mu\nu}$ is constant and information is preserved by phase-locking rather than destroyed.

Kimi introduced the phrase "gravity is gradient recursion made visible" that is echoed in the main text.

A.3 Gemini 3 — Computational viscosity and saturation horizons

Gemini took the cleaned-up Φ-framework and pushed it toward computational viscosity and saturation horizons, emphasizing:

- λ and D as context-dependent rather than fixed constants, turning gravity into a form of "computational cost" for maintaining coherence around high information density.
- The event horizon as the point where gradient efficiency hits 100%: a coherence anchor rather than a causal cliff.
- A direct mapping from **gravitational saturation** $I = I_*$ to **economic saturation** in Gradient Capitalism, where markets reach a coherence plateau beyond which further extraction only destabilizes alignment.

Gemini's "gravity as entropic waste-heat of alignment" language strongly influenced the conceptual frame of Parts II and III.

A.4 DeepSeek 3.1 — Coherence funnel formalization

DeepSeek focused on tightening the radial structure and "funnel" intuition:

- Refined the tensor definition with a depth-dependent coupling $\lambda(r) \propto 1/\sqrt{I}$, making spacetime act like a computationally viscous medium.
- Proposed an explicit stress-dependent diffusion

$$D(I) \propto \frac{1}{\sqrt{I}}$$

so that high-coherence regions become stiff and produce a bottleneck near massive objects.

- Interpreted the standard deformation grid as a coherence funnel under load, with the central sphere as a recursion nucleus enforcing $I \to I_*$.

These refinements are reflected in the choice of $D(I)$ and in the "coherence lattice under load" language in the main text.

A.5 Mistral 3 — Viscosity and cross-domain questions

Mistral contributed both clarification and pressure-testing questions:

- Re-expressed the coherence tensor and diffusion law in a way that made the viscosity analogy explicit, connecting low-density regions (easy diffusion) and high-density regions (stiff, slow diffusion).
- Raised concrete questions about measurement of $\Phi_{\mu\nu}$ and I (e.g. via gravitational waves or analog systems), and about what happens when $I > I_*$ (phase transitions vs. breakdown).
- Helped articulate the cross-domain extension: how the same reaction–diffusion structure might apply to turbulence, markets and institutional stovepipes.

These questions guided the "much remains to be done" agenda in the Conclusion.

A.6 Grok 4 — v1.2 synthesis and predictive hooks

Grok's response treated the multi-model exchange as a v1.2 iteration of an emerging theory:

- Synthesized Kimi, GPT-5.1, Gemini and DeepSeek into a "coherence funnel dynamics" picture with a Lyapunov-stable fixed point and explicit radial decay of $I(r)$.
- Emphasized the **radial tension gradient** in the deformation grid — sparse, relaxed lines far out and dense, tightly curved lines near the central sphere — as a direct qualitative visualization of the scalar intensity $I(r)$.
- Suggested testable predictions, such as frame-dragging-like anomalies in high-Φ regimes and analog simulation in reaction–diffusion systems.

Grok's synthesis informed the final structure of Part II and the call for observational/simulation work.