⚙️ Phase 7 – Part 2: Field Stability and Boundary Behavior

Goal of this Part: Examine whether the upgraded gravitational field:

Plain-text equivalent:

Gravity(x) = (∇²[space(x) + current(x)²]) ⋅ ψ(x)

maintains physical consistency, mathematical stability, and well-behaved boundaries under dynamic ψ-fields and current(x). I focus on:

* Identifying conditions under which the field avoids runaway growth or decay.
* Determining whether ψ(x) or current(x)² can cause divergences or undefined regions.
* Establishing rules for boundaries (e.g., ψ = 0, ψ → ∞, or current → ∞) that maintain finite and meaningful Gravity(x).
* Preparing for later simulations of dynamic feedback and propagation.

1. Restating the Equation with Emphasis

My upgraded equation:

Plain-text equivalent:

Gravity(x) = (∇²[space(x) + current(x)²]) ⋅ ψ(x)

Component roles:

* ∇²[…] = spatial Laplacian → measures local curvature or “depth” of combined geometry and flow.
* space(x) = baseline geometry (could be warped, curved, etc.).
* current(x)² = squared dynamic “wind” through ψ, includes reversibility unlike time².
* ψ(x) = modulates curvature and effectively scales how the curved substrate pushes or pulls on particles.

1. Field Stability Conditions

To prevent singularities or instabilities in Gravity(x), I analyze each component.

1. Laplacian Blow-Up Control

Laplacian ∇²f(x) is sensitive to sharp changes or discontinuities in the second derivative.

Let:

Then:

Plain-text equivalent:

f(x) = space(x) + current(x)²

Gravity(x) = (∇² f(x)) ⋅ ψ(x)

For stability:

* f(x) must be at least C² smooth.
* ∇²f(x) must be bounded, or diverging only where ψ(x) → 0 (so Gravity remains finite).
* ψ(x) must not amplify any singularities in ∇²f(x).

1. ψ(x) Blow-Up Zones

Problematic if:

* ∇²f(x) is finite, but ψ(x) → ∞ ⇒ unbounded gravity.
* ∇²f(x) is divergent, and ψ(x) ≠ 0 ⇒ singular gravity.
* ψ(x) = 0 and ∇²f(x) ≠ 0 ⇒ nullified gravity zones (vacuum-like).

Stability condition:

Plain-text equivalent:

|Gravity(x)| < ∞ ⇒ ψ(x) ∈ R\_bounded, ∇²f(x) ∈ R\_bounded

1. Regularizing ψ and current with decay

Propose Gaussian-type behaviors:

Then:

1. Boundary Behavior

Assuming 1D space for clarity.

Case A: ψ(x) → 0 at ∞

Then:

* Gravity(x) → 0
* Matches physical intuition: far from source, field vanishes.

Case B: current(x) → constant

If current(x)² is flat:

Then:

* ∇²f(x) could be smooth, but Gravity(x) will sharply cut to zero.
* Models abrupt gravitational cutoff (e.g., edge of a mass distribution or ψ-boundary).

1. General Stability Conditions

To ensure Gravity(x) remains meaningful:

* Stability Rule 1: ψ(x) must decay or saturate at large x. No poles or asymptotes.
* Stability Rule 2: current(x)² must be continuous and differentiable up to second order.
* Stability Rule 3: space(x) must be C² smooth (or piecewise with well-matched edges).
* Stability Rule 4: Avoid configurations where both ∇²f(x) and ψ(x) diverge — this breaks predictivity.

Summary of Part 2

In this part, I:

* Established field stability criteria for my upgraded ψ-gravity equation.
* Defined behavioral constraints to avoid blowups in ψ, ∇², or current(x).
* Explored boundary behavior in flat, decaying, and discontinuous cases.
* Included a ready-to-run Python simulation template for 1D analysis: