# Coupled Dynamics of ψ and Curvature — 1D Simulation and Field Feedback

## 🎯 Objective

To simulate the first coupled interaction between the generative ψ field and the emergent curvature in a simplified 1D system. We aim to numerically investigate how ψ influences gravity through curvature, and how curvature feeds back into ψ, forming a self-organizing dynamical loop.

## 🧾 Key Definitions

| Symbol | Meaning |
| --- | --- |
| ψ(x) | Generative field — pre-physical substrate affecting spacetime curvature |
| space(x) | Scalar representation of spatial configuration (here: x) |
| time² | Static scalar term encoding directional flow (set to 1.0) |
| ∇²[f(x)] | Discrete Laplacian operator (measuring curvature of a scalar field) |
| Gravity(x) | Emergent gravitational “pressure” from curvature × ψ |

## 🧮 Equations Used

### 🔹 Initial ψ Field (Gaussian)

Plaintext:  
psi\_0(x) = A \* exp(-((x - x0)^2) / (2 \* σ^2))

### 🔹 Curvature Field (Laplacian of space + time²)

Let:

Plaintext:  
curvature(x) = Laplacian(x + 1.0)

This curvature is computed via the second-order central difference formula:

Plaintext:  
laplacian(x) ≈ (f[x+1] - 2\*f[x] + f[x-1]) / dx^2

### 🔹 Updated ψ Field (1-Step Feedback)

Plaintext:  
psi(x) = psi\_0(x) + β \* curvature(x)

### 🔹 Emergent Gravity

Plaintext:  
gravity(x) = curvature(x) \* psi(x)

## 📉 Diagram: Field Evolution in 1D

Here’s the 1D simulation result for 100 spatial points:

* Dashed Blue: Initial ψ field (Gaussian shape)
* Orange: Curvature from Laplacian of x + time²
* Green: Gravity(x) = curvature × ψ(x)

The gravity profile reveals how ψ amplifies or dampens curvature depending on its value.  
(Plot shown above)

## 🧠 Interpretation

* The curvature of a linear + constant field (x + 1.0) yields a near-zero curvature across the domain — except at the edges (due to boundary effects).
* ψ’s Gaussian bump gets minimally adjusted by curvature due to this near-flat profile.
* Gravity, being the product of curvature and ψ, also peaks only where ψ is high and curvature non-zero — revealing localized gravity zones.
* The interaction suggests that ψ acts as a lens, magnifying curvature effects.

## 🌊 Analogy View (Ocean)

| Ocean Analogy Element | Mapped Concept |
| --- | --- |
| Ocean Bed | ψ field |
| Water Level Gradient | space + time² |
| Pressure Zones | Curvature × ψ (Gravity) |

## ⚙️ Simulation Notes

* Grid: 100 points; spacing dx = 1
* Initial ψ: Gaussian centered at midpoint, σ = 3.0
* Curvature: Laplacian of x + 1.0, which should be ≈ 0 in center, non-zero near edges
* β = 0.1: Controls how much ψ reacts to curvature
* No boundary padding yet — future simulations should test Neumann/Dirichlet edges