📘 Phase 5 – Part 5.4: Dynamic ψ Evolution via Klein-Gordon Equation

We now bring the ψ field to life—allowing it to evolve dynamically over time and space. This part introduces oscillations, wave propagation, and energy transmission within the ψ substrate, marking a transition from static curvature to dynamic, time-responsive behavior.

🧠 Governing Equation: Klein-Gordon Form

We define the evolution of ψ(x, t) with a wave equation that includes a mass-like term:

Plaintext:  
∂²ψ/∂t² − ∇²ψ + mψ²·ψ = 0

This is the continuous version, capturing the essence of wave motion plus decay due to “mass”.

🧮 Symbolic Formulation (1D)

Using symbolic math (1D form):

This can also be written symbolically as:  
Eq(m\_psi\*\*2 \* ψ(x, t) + ∂²ψ/∂t² − ∂²ψ/∂x², 0)

🧪 Physical Interpretation

• ∂²ψ/∂t²: Describes the acceleration of ψ in time—how ψ “vibrates” or evolves.  
• −∇²ψ: Describes spatial curvature—how ψ “spreads” or disperses across space.  
• + mψ²ψ: A restoring force that damps or confines the ψ field, like a spring or potential.

This mass term causes localized ψ waves to disperse less, leading to decaying or standing oscillations.

🔁 Next Steps

We will now:  
1. Discretize this equation (into ψₙ₊₁ form)  
2. Use a finite difference method to simulate it numerically  
3. Observe propagation of ψ(x, t), and then recalculate:  
- Gravity(x, t) = ∇²[space + time²] × ψ(x, t)  
- Force(x, t) = −∇[Gravity(x, t)]