# Ripples in Spacetime: A Framework for Visualizing Quantum Branching

Summary for Prof. Matthew Kleban | NYU Center for Cosmology and Particle Physics

## Core Premise

This framework explores a novel approach to visualizing wavefunctions by treating time as a radial coordinate (r = ct) and mapping space angularly (θ = function(x)) within a polar system. Grounded in Minkowski geometry, it draws a surprising parallel to the branching structure of the Many-Worlds Interpretation (MWI). The framework represents quantum states, interference, and superposition as evolving 'ripples' or perturbations through spacetime—capturing both amplitude and phase in a unified geometric view.  
  
In this model, amplitude no longer corresponds to a single local state but an overlapping probability space—for example, the likelihood of detecting a particle at positions x1 and x2 at a shared time y1. Interference and superposition are naturally encoded. Each radial line in the polar coordinate system reflects one observer's measured experience in a particular outcome branch.  
  
The Dirac equation is used to represent measurable outcomes including antimatter, and the Klein–Gordon equation provides a foundation for early demonstrations. This approach emerged from the goal of interpreting time as a fourth spatial dimension.

## Key Mathematical Transformations

• r = ct → Time as radial distance  
• θ = function(x) → Position mapped angularly  
• Amplitude and phase encoded in brightness and hue, respectively  
• Overlapping regions represent interference or coherence between branches  
• Future direction: r = √(gμν dxμ dxν) to explore time as a function of the metric tensor

## Physics Foundations

• Based on Minkowski spacetime and special relativity (invariant interval, time dilation)  
• Inspired by the Many-Worlds Interpretation to visualize branching outcomes  
• Utilizes Klein–Gordon and Dirac equations for proof-of-concept simulations  
• Encodes multiple quantum outcomes in angular sectors of spacetime

## Next Steps and Research Goals

I plan to revise and formalize this model, re-derive key results, and develop clearer visual tools. My goal is to learn how to approach formal publication and contribute meaningfully to the field. I would be honored to support your ongoing research and gain deeper insight into publishing methods and theoretical rigor under your mentorship.