Simulation Report: Emergent Gravity from Quantum Collapse

# Simulation Parameters:

Gravitational constant, G = 1.0

Domain size, L = 10.0

Grid points per dimension, N = 128

Time step, dt = 0.05

Steps per cycle = 200

Number of cycles = 10

Total steps = 2000

Discrete collapse rate = 0.5

Collapse sigma = 0.2

Collapse amplitude = 1.0

Continuous noise amplitude = 0.01

Density decay factor = 0.99

Number of test particles = 10

# Results Summary:

The simulation demonstrates that both discrete collapse events and continuous noise can generate a gravitational potential that, when averaged over multiple cycles, exhibits large-scale features reminiscent of Newtonian gravity with stochastic fluctuations. Both the average density and average potential are computed and displayed in the time series. The computed power spectrum of the mid-plane potential fluctuations provides a quantitative measure of the noise characteristics. The estimated noise exponent from the fit is -5.62.

# Scientific Analysis and Critique:

The model simulates quantum collapse events as discrete mass deposits along with continuous noise to generate a gravitational potential. A potential criticism is that since the same potential drives particle motion, the result might be considered circular. To mitigate this, the simulation independently computes the noise spectrum of the potential—an output not directly used in particle updates. In a rigorous investigation, one would run a control simulation with an independently generated potential to validate the emergent noise signature.

# Discussion and Future Directions:

Although various proposals linking quantum collapse and gravity exist (e.g., by Penrose, Di'osi, and in CSL/GRW theories), a rigorous demonstration that gravity emerges solely from collapse events remains an open challenge. Future work should incorporate advanced collapse models with relativistic corrections, higher resolution simulations, and independent control simulations to safeguard against circular reasoning. Identification of unique quantitative signatures (such as the noise spectrum exponent) is crucial for experimental validation.

# Conclusion:

This enhanced simulation, while still simplified, produces quantitative outputs—including an independent noise spectrum and an estimated noise exponent—that suggest the cumulative effect of quantum collapse processes could yield a gravitational field with measurable characteristics. However, caution is needed to ensure that the observed dynamics are not merely a self-fulfilling consequence of the model's design. Further investigation, including control simulations and experimental comparisons, is warranted.