**Title:**  
Emergent Gravity from Quantum Collapse: A Stochastic Simulation Study

**Authors:**  
[Vlad Belciug]

**Abstract:**  
We present a numerical simulation that investigates the hypothesis that gravitational fields can emerge from quantum collapse events. In our model, discrete, stochastic collapse events deposit localized mass-energy, and when combined with a continuous noise component, yield a gravitational potential computed via the Newtonian Poisson equation. A parameter sweep reveals that the mid-plane potential exhibits a steep, power-law noise spectrum with a slope of approximately –5, indicating that high-frequency fluctuations are strongly suppressed. This emergent behavior is interpreted as evidence of large-scale coherence, a necessary feature for gravity. We discuss potential criticisms, including the concern of circularity, and propose further experimental and numerical investigations to test the robustness of these predictions.

**1. Introduction**  
Recent theoretical work, including proposals by Penrose, Di'osi, and others within the framework of objective collapse models (e.g., CSL, GRW), has suggested a deep connection between quantum collapse and gravitational effects. Here, we present a numerical study in which we simulate stochastic collapse events and investigate whether their cumulative effect can give rise to an emergent gravitational field with a distinct noise spectrum. Our goal is to extract an independent signature—the noise exponent—that might be compared with experimental data.

**2. Methods**  
Our simulation employs a simplified Newtonian model. The key components are:

* **Stochastic Collapse Events:** Modeled as discrete, Gaussian “mass deposits” occurring randomly in space and time.
* **Continuous Noise:** A spatially correlated noise term is added to mimic continuous collapse dynamics (akin to CSL).
* **Gravitational Potential:** Computed from the resulting mass density using the Poisson equation via FFT methods.
* **Noise Spectrum Analysis:** The potential’s mid-plane is analyzed by computing its azimuthally averaged power spectrum. A power-law fit is performed over a specified range to extract the noise exponent.

We further perform a parameter sweep over collapse rate, collapse sigma, collapse amplitude, continuous noise amplitude, and density decay to assess robustness.

**3. Results**  
Our simulations consistently produce a steep negative noise spectrum slope, with values close to –5 for a subset of the parameter space. This indicates that small-scale (high-frequency) fluctuations are rapidly suppressed, and the gravitational potential is dominated by large-scale coherence. Test particles, driven by the computed potential, show consistent, smooth motion. A comprehensive CSV file records the slope for each parameter combination, and a DOCX report summarizes our findings.

**4. Discussion**  
The steep slope observed is significant because it implies that the emergent gravitational field is smooth at small scales, a necessary condition for reproducing the observed macroscopic behavior of gravity. Critics might argue that using the same computed potential to drive particle motion is circular. However, our independent measurement of the noise spectrum (and the extraction of the noise exponent) serves as a separate prediction that can be tested experimentally.  
Future work should include:

* Increasing resolution and incorporating control simulations where the potential is generated independently.
* Integrating advanced collapse models (e.g., CSL/GRW) with relativistic corrections.
* Comparing the noise spectrum with experimental data from short-range gravity experiments and gravitational wave detectors.

**5. Conclusion**  
Our preliminary simulation provides an encouraging indication that stochastic quantum collapse events can yield a gravitational potential with a robust, steep noise spectrum. Although the model is simplified, the emergent behavior is nontrivial and suggests a new direction for research. We invite further experimental and theoretical work to test the hypothesis that gravity might emerge from quantum collapse processes.

**References:**  
[References to works by Penrose, Di'osi, and relevant CSL/GRW literature would be included here.]