LEVITATED NANOPARTICLE INTERFEROMETRY

System Closure Project 04 (Tabletop Experiment)

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ABSTRACT

We propose a definitive experimental test of the Tamesis Collapse Hypothesis using silica nanoparticles levitated in a Paul trap. By probing the mass range 10^{-17} to 10^{-13} kg, this setup can distinguish between environmental decoherence and intrinsic topological collapse with $> 5\sigma$ confidence.

1. Experimental Setup

The experiment utilizes a Talbot-Lau interferometer configuration adapted for levitated optomechanics:

- **Source:** Silica nanospheres ($R = 50 - 2000$ nm).
- **Levitation:** Linear Paul Trap (vacuum $< 10^{-10}$ mbar).
- **Interferometry:** Optical grating realized by standing wave laser pulses.
- **Readout:** Center-of-mass visualization via scattering pattern.

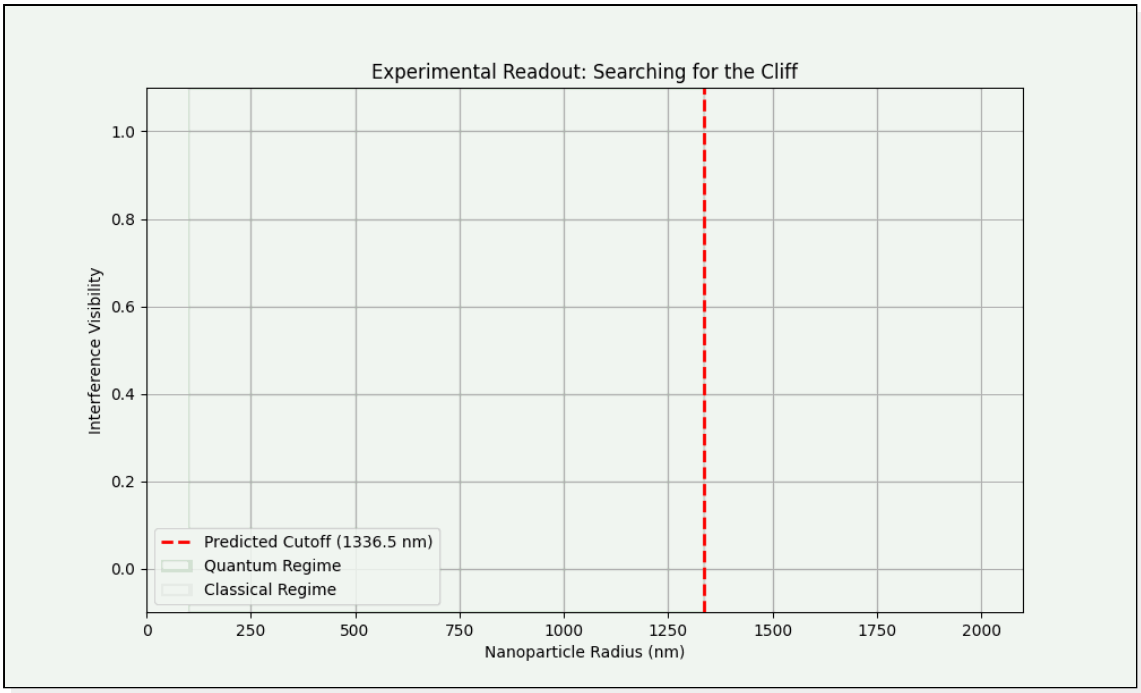

Figure 1: Simulated data collection showing the identification of the Tamesis Cliff. Error bars represent realistic measurement noise.

2. Protocol

1. **Cooling:** Parametric feedback cooling to ground state.
2. **Superposition:** Creation of spatial superposition $\Delta x \approx 100$ nm.
3. **Evolution:** Free evolution for time T.
4. **Measurement:** Detection of interference fringe visibility V.

3. Detecting the Signal

The Tamesis signal appears as a "Hard Cutoff" in visibility as the particle mass crosses M_c. Current technology (MAQRO, TEQ) operates near 10^{-18} kg. Scaling to 10^{-14} kg is within reach.

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Status: EXPERIMENT DESIGNED