

New Windows on Fundamental Physics: from tabletop devices to large scale detectors



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Probing the gravity-quantum interface with interferometers and nanoparticles

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Proposed theories of harmonizing gravity and quantum mechanics at low energies suggest novel features such as fluctuations in the spacetime metric and collapse of massive quantum superpositions. How can these features be probed experimentally?

We have recently shown how high-precision tabletop laser interferometers can distinguish different classes of spacetime fluctuations as characterized by their correlation functions. Focussing on functions that decay either exponentially or polynomially with spacetime separation can provide evidence for or against classes of novel theories uniting gravity with quantum mechanics.

Understanding the interface of quantum mechanics and gravity also requires testing the superposition principle for increasingly massive objects. I will present a proposal for such a test using levitated charged nanoparticles. This tabletop experiment can probe such collapse, particularly from cosmological origins, more robustly than X-ray emission studies from facilities such as XENONnT.

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