

Precision tests on the quantum nature of gravity

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Project Summary:

This project can explore a number of different and related directions and will be student led. It could involve general theoretical research, or involve work closer to experiment and quantum devices. The project could aim to explore a number of experimental architectures which make use of quantum technologies to probe the quantum vs classical nature of gravity. The primary signature we propose to look for, is gravitational diffusion, which has been shown to be a necessary signature of coupling quantum fields to classical spacetime. One system which has shown great promise, is optical Michelson interferometers, which make use of squeezed state quantum enhancement and homodyne readout, which can look for stochastic signals in the gravitational field. The absence of such signals would confirm that the gravitational field is not classical, while a positive test points strongly to the theory outlined in <https://journals.aps.org/prx/abstract/10.1103/PhysRevX.13.041040>

Other directions for the project include using gravitationally mediated entanglement to test the quantum nature of spacetime, precision tests of gravity at short distances, or more theoretical work to derive general features of quantum vs classical spacetime.

Contact: Email j.oppenheim@ucl.ac.uk with PhD in the subject line, should you have further questions.