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## Can tabletop experiments discover the graviton?

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We argue that if the Newtonian gravitational field of a body can mediate entanglement with another body, then it should also be possible for the body producing the Newtonian field to entangle directly with on-shell gravitons. Our arguments are made by revisiting a gedankenexperiment previously analyzed by Belenchia et al., which showed that a quantum superposition of a massive body requires both quantized gravitational radiation and local vacuum fluctuations of the spacetime metric in order to avoid contradictions with complementarity and causality. We provide a precise and rigorous description of the entanglement and decoherence effects occurring in this gedankenexperiment, thereby significantly improving upon the back-of-the-envelope estimates given in the analysis of Belenchia et al. and also showing that their conclusions are valid in much more general circumstances. As a by-product of our analysis, we show that under the protocols of the gedankenexperiment, there is no clear distinction between entanglement mediated by the Newtonian gravitational field of a body and entanglement mediated by on-shell gravitons emitted by the body. This suggests that Newtonian entanglement implies the existence of graviton entanglement and supports the view that the experimental discovery of Newtonian entanglement may be viewed as implying the existence of the graviton.

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### **In-person or Virtual?**

Virtual

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