



Joint Quantum Sciences Seminar

Wednesday, Feb 11, 4:00 pm
Jefferson 250

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Measurements Beyond the Heisenberg uncertainties

Some operations on quantum states are not restricted by the Heisenberg uncertainty principle. One example is teleportation, which allows for both the position and the momentum be transferred without added noise [1]. Perhaps even more surprisingly, a trajectory of an oscillator can be measured with an accuracy exceeding the Heisenberg uncertainty in both position and momentum following the approach we have recently developed [2]. The key feature is to monitor the oscillator trajectory in a quantized reference frame with a negative mass with which the oscillator is entangled. In the talk I will first present a magnetic spin oscillator with an effective negative mass and report the results of tracing the oscillator trajectory and entanglement-assisted measurements of magnetic field [3]. I will then describe experimental progress towards tracing a trajectory of a mechanical oscillator with the precision not restricted by the Heisenberg uncertainty principle following the proposal [4].

1. H. Krauter et al. *Nature Phys.*, 9, 400 (2013).
2. E.S. Polzik and K. Hammerer, *Ann. Phys. (Berlin)* 527, No. 1–2, A15–A20 (2015).
3. G. Vasilakis et al, to appear in *Nature Phys.*; W. Wasilewski et al. *Phys. Rev. Lett.*, 104, 133601 (2010).
4. K. Hammerer, M. Aspelmeyer, E.S. Polzik, P. Zoller. *Phys. Rev. Lett.* 102, 020501 (2009).

Student Presentation by Peter Komar, Lukin Lab, will begin at 4:00 PM

Guest Presentation will begin at 4:30 PM

Refreshments will be provided