Spring 2025 Physics Colloquium

Friday, February 14th

3:00 PM

PAS 201 or Zoom (**https://arizona.zoom.us/j/86395646910**)

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Quantum metrology and sensing with an atomic spatial superposition state coherent for one minute

Abstract: Exceptional levels of quantum control and coherence are necessary for performing quantum metrology and sensing with the utmost precision. Atom interferometers are powerful in both probing fundamental physics and everyday sensing, but the use of atoms in free fall has so far limited their measurement times to a few seconds. I will describe how we realize interferometers with atoms suspended in an optical lattice for an unprecedented 70 seconds. I will show how, for the first time, we (1) optimize the gravitational sensitivity of the lattice interferometer and (2) use a system of signal inversions and switches to suppress and quantify systematic effects. This enables us to measure the attraction of a miniature source mass with record accuracy of 6.2 nm/s2, less than a billionth of Earth's gravity and four times as good as the best similar measurements with freely falling atoms. This performance demonstrates the advantages of lattice interferometry in fundamental physics measurements. I will then show how the lattice atom interferometer can overcome the limits of current atomic gravimeters for applications in the field. Finally, I will discuss current progress towards next-generation lattice atom interferometers and their applications in searching for new physics and quantum inertial sensing in the real world.

**** Refreshments served in PAS 218 at 2:30 PM – 3:00 PM ****

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