CSU PHYSICS COLLOQUIUM

"Quantum Backaction-Limited Measurements in Bose-Einstein Condensates"

Emine Altuntas

University of Maryland

Monday February 14th at 4:00pm

120 Engineering (Hammond Auditorium)

Abstract

In recent years, there have been rapid breakthroughs in quantum technologies that offer opportunities for fundamental physics discoveries and advanced understanding of basic quantum phenomena. The principal tenet of quantum technologies has two sides: quantum measurement and quantum control. Nonetheless, the study of many-body quantum systems under these conditions is very much in its infancy. Ultracold atoms - our workhorse for quantum simulation, are an ideal platform for understanding the system-reservoir dynamics of many-body systems. Bose-Einstein condensates (BECs) offer multitude of non-destructive imaging methods, which are weak measurement techniques that yield a controlled reservoir and consequently allow time-resolved study of the system evolution paving the way for real-time control of quantum gases. To this end, I will describe our versatile high-resolution ultracold atom microscope: a combined hardware/software system that recovers near-diffraction limited performance and maximizes the information that is read out. Our high-fidelity digital correction technique reduces the contribution of photon shot noise to density-density correlation measurements which would otherwise contaminate the quantum projection noise signal in weak measurements [1]. In this perspective, I will discuss the experimental characterization of the quantum projection noise from the measurement process via phase contrast imaging (PCI) technique. Finally, I will present a matter-wave beamsplitter experiment in BECs and our latest results acquired using partial-transfer PCI technique.

[1] E. Altuntas, and I. B. Spielman, Physical Review Research, 3, 043087 (2021).

Biography

Emine Altuntas is a postdoctoral researcher at the National Institute of Standards and Technology Gaithersburg and the Joint Quantum Institute in Dr. Ian Spielman's group. She received her B.A. from Amherst College in physics and political science in 2011. Subsequently she received her Ph.D. in 2017 from Yale University where in Prof. David DeMille's group she studied parity violation effects in diatomic molecules to characterize strong-force induced modifications of electroweak interactions. Her current research focuses on quantum backaction limited measurements in ultracold atoms towards the realization of open quantum systems. Her research interests include precision measurements of violations of discrete spacetime symmetries, and quantum measurement and quantum control with ultracold neutral atoms.