Speaker: Dr. Bhuvanesh Sundar

Time: 11:00am-12:00pm

Location: Whitaker Biomedical Engineering 1103

Title: Quantum metrology with multilevel atoms in optical cavities

Abstract: Optical atomic clocks are some of the most precise measurement systems we have available to measure physical parameters. Based on the manipulation and control of ultracold strontium atoms, today's atomic clocks have a precision that can resolve gravitational redshifts on the millimeter scale! Exploiting quantum entanglement in the form of spin squeezing promises to be an enabling development to improve the precision of atomic clocks beyond the standard quantum limit of unentangled atoms.

In this talk, I will describe two ideas to produce spin-squeezed states of ultracold alkaline earth atoms trapped in an optical cavity, that utilize their multilevel atomic structure. First, I will describe how to use cavity-mediated unitary interactions between multilevel atoms to produce a two-mode squeezed state, and utilize it for quantum metrology. I will discuss the robustness of this method to decoherence in the form of collective and single-particle emission of light. Second, I will describe how dissipation in the form of collective light emission into the cavity can be used to robustly produce a two-mode squeezed state with multilevel atoms. I will conclude by discussing prospects for multimode-squeezed multilevel atoms in quantum metrology.

Bio: I conduct research at the intersection of atomic, molecular and optical physics, quantum information science, and condensed matter physics. My research has included topics in quantum simulation of many-body physics with ultracold gases, variational quantum algorithms for probing quantum systems and solving combinatorial optimization problems, and quantum metrology with ultracold atoms. I completed my Masters and PhD in physics at Cornell University, did postdoctoral research with Kaden Hazzard at Rice University, Peter Zoller at the Austrian Academy of Sciences, and Ana Maria Rey at the University of Colorado, Boulder. I'm currently a research engineer working towards achieving quantum advantage at Rigetti Computing.