MONTANA STATE UNIVERSITY | College of LETTERS & SCIENCE

Physics Colloquium

Monday, March 27th
4:10 – 5:00 PM
Roberts Hall Room 101

Atoms in Cavities for Quantum Science

Dr. Matthew Jaffe, University of Chicago

Abstract:

Recent years have witnessed substantial developments in quantum science and growing interest in its applications. Technologies ranging from photonics to superconducting circuits hold promise for quantum computing, improved sensing and more. In particular, both photons and cold atoms have emerged as promising building blocks. Photons can be readily generated with tightly controlled properties, and can carry quantum information over long distances. Meanwhile, atoms constitute tiny, identical quantum systems that can be well-controlled and manipulated, crucially including the ability to interact with the environment and/or each other.

In this talk, I will present two experimental platforms coupling atoms to photons for quantum science. I will first discuss the construction and use of the world's first atom interferometer in an optical cavity. Atom interferometry is a precision measurement technique utilizing the matter wave nature of atoms in analogy to a light interferometer. After presenting the basics of atom interferometry, I will describe how this cavity-enhanced atom interferometer was used to search for dark energy, to create the longest-duration (20 seconds) superposition of an atom in two locations, and more.

I will then discuss a quantum many-body physics simulation platform utilizing hybrid particles known as Rydberg polaritons. These particles are part photon and part atomic Rydberg (high-n) excitation, combining the strong interactions of Rydberg atoms with the quantum optics toolkit. By shaping the photonic Hamiltonian via optical resonator design, this system can host strongly-interacting topological fluids of light. I will present the premises and enabling technologies behind these claims, as well as progress towards generation of mesoscopic fractional quantum Hall states using photons.

Host: Randy Babbitt

**** Refreshments served in the Barnard second floor atrium at 3:30pm ****