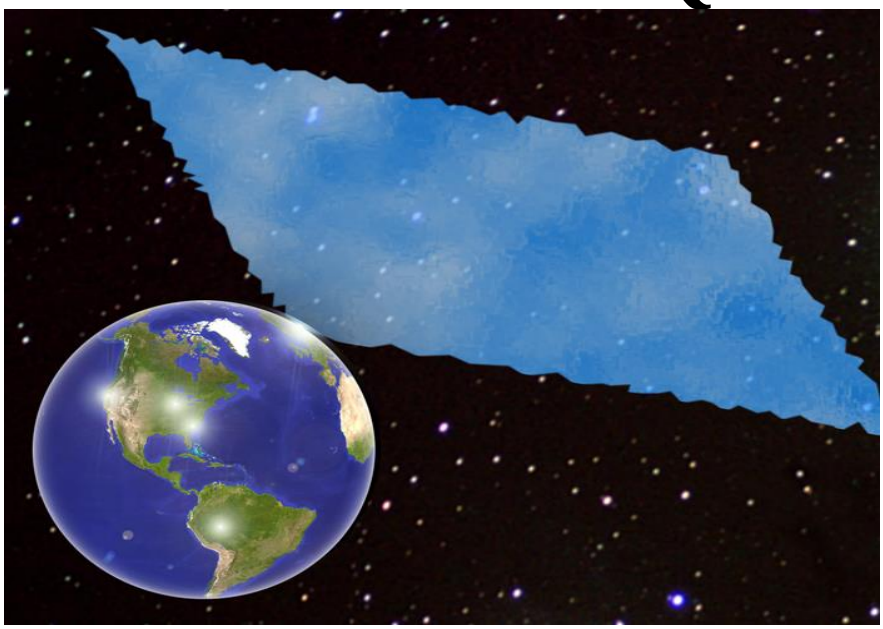
PHYSICS COLLOQUIUM



Dr. Derek Kimball
California State University, East Bay

Searches for Ultralight Bosonic Dark Matter

Abstract

We believe that over 80% of the matter in the universe is a mysterious invisible substance known as "dark" matter. This belief is based on a wide variety of observational evidence: galactic and stellar dynamics, gravitational lensing studies, measurements of the cosmic microwave background radiation (CMB), structure formation in the universe, and the abundance of light elements. But what exactly is dark matter? This is a complete mystery. Unravelling the nature of dark matter requires measuring non-gravitational interactions between dark matter and Standard Model particles and fields. One of the leading hypotheses is that dark matter consists of ultralight bosons such as axions or hidden photons. Axions and hidden photons can have extremely small masses and thus long Compton wavelengths and hence behave like classical waves. Such wavelike ultralight bosonic dark matter (UBDM) fields may interact with atomic spins, electromagnetic fields, and/or the gluon field. In this talk we will discuss recent results from three experiments that search for such interactions of UBDM: (1) the Cosmic Axion Spin Precession Experiment (CASPEr), where nuclear magnetic resonance (NMR) techniques are being used to search for oscillating nuclear electric dipole moments induced by the axion-gluon interaction; (2) the Global Network of Optical Magnetometers for Exotic physics searches (GNOME), where a worldwide array of shielded optical atomic magnetometers is used to search for transient signals associated with a UBDM-spin interaction upon passage of Earth through large, composite UBDM objects such as an axion stars or domain walls; (3) the Search for Non-Interacting Particles Experimental Hunt (SNIPE Hunt), where the Earth itself acts as a transducer to convert UBDM into detectable magnetic field signals that can be measured with unshielded magnetometers located in remote, magnetically quiet environments.

3:00 p.m. – 4:30 pm, Friday, March 10th,
In-Person: McLane 162