Miami Physics Conference 2023

Date: Dec 13-19, 2023

Location: LagoMar Resort

Affiliation: University of Illinois Urbana Champaign

Christina Gao

Axion Wind Detection with the Homogeneous Precession Domain of the Superfluid He-3

Abstract

Axions and axion-like particles may couple to nuclear spins like a weak oscillating effective magnetic field, the "axion wind." Existing proposals for detecting the axion wind sourced by dark matter exploit analogies to nuclear magnetic resonance (NMR) and aim to detect the small transverse field generated when the axion wind resonantly tips the precessing spins in a polarized sample of material. We describe a new proposal using the homogeneous precession domain (HPD) of superfluid He-3 as the detection medium, where the effect of the axion wind is a small shift in the precession frequency of a large-amplitude NMR signal. A detailed study of the statistical and dynamical properties of the HPD system is included, as well as the effects of clock error and measurement error in a readout scheme using superconducting qubits and quantum metrology. Incorporating an optimal data-taking and analysis strategy, the proposed setup has competitive sensitivity to other axion wind experiments, such as CASPEr-Wind, for the axion masses below 100 neV.