Contribution ID: **6** Type: **not specified**

Statistics of axion wind detection with superfluid Helium-3

Saturday, 4 May 2024 09:55 (20 minutes)

The homogeneous precession domain (HPD) of superfluid ^{3}He has recently been identified as a detection medium which might provide sensitivity to the axion-nucleon coupling g_{aNN} competitive with, or surpassing, existing experimental proposals. In this work, we make a detailed study of the statistical and dynamical properties of the HPD system in order to make realistic projections for a full-fledged experimental program. We include the effects of clock error and measurement error in a concrete readout scheme using superconducting qubits and quantum metrology. This work also provides a more general framework to describe the statistics associated with the axion gradient coupling through the treatment of a transient resonance with a non-stationary background in a time-series analysis. Incorporating an optimal data-taking and analysis strategy, we project a sensitivity approaching $g_{aNN} \sim 10^{-12}$ GeV^{-1} across a decade in axion mass.

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Yes

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Session Classification: Talks