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A search for axionlike dark matter with the CASPEr-gradient Low-Field experiment

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Axions and other light pseudoscalar bosons with masses below $1\,\mathrm{eV}/c^2$, collectively referred to as axionlike particles (ALPs), are among the most well-motivated dark matter (DM) candidates.
The Cosmic Axion Spin Precession Experiment (CASPEr)\,[1] aims at detecting axionlike DM with nuclear magnetic resonance techniques.
CASPEr-Gradient in Mainz probes the coupling of nuclear spins to a galactic DM halo consisting of ALPs.
Here, a spin-polarized sample within a leading field could acquire a measurable transverse magnetization due to the effect of the ALP field gradient, which acts as a pseudo-magnetic field\,[2].
The Low-Field apparatus of CASPEr-Gradient was designed to search for ALPs with Compton frequencies between $1\,\mathrm{kHz}$ and $4.3\,\mathrm{MHz}$, corresponding to an approximate mass range of 10^{-12} to $10^{-8}\,\mathrm{eV}/c^2$.
We report the first measurement on a thermally polarized liquid methanol sample at a $317\,\mathrm{G}$ leading field, where we scanned for ALP signals within a $250\,\mathrm{Hz}$ bandwidth around $1348500\,\mathrm{Hz}$.

[1] D. F. J. Kimball et al. “Overview of the Cosmic Axion Spin Precession Experiment (CASPEr)”. In: \emph{Microwave Cavities and Detectors for Axion Research.} Cham: Springer International Publishing, 2020, pp.~105–121. ISBN:~978-3-030-43761-9

[2] P. W. Graham and S. Rajendran. “New observables for direct detection of axion dark matter”. In: \emph{Phys. Rev. D}~88 (3 Aug. 2013), p.~035023. DOI: 10.1103/PhysRevD.88.035023.

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