

Towards axionic dark matter measurements with CASPER-gradient

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Axions and axion-like particles (ALPs) are well-motivated dark matter candidates which are collectively referred to as ALPs. The Cosmic Axion Spin Precession Experiments (CASPER) [1] is an international research program searching for ALPs using nuclear magnetic resonance (NMR) techniques. CASPER-gradient low-field in Mainz probes the hypothetical coupling of the gradient of the ALP field to nuclear spins [2] for Compton frequencies between 1 kHz and 4.2 MHz using a tunable superconducting magnet and a detection system based on superconducting quantum interference devices (SQUIDs). To probe higher frequencies in the range 70 to 600 MHz CASPER-gradient high-field was recently installed and is currently operating in Mainz. The setups and recent experimental efforts of CASPER-gradient are presented including a demonstration measurement with thermally-polarized sample to search for ALPs at a Compton frequency of 1.3 MHz.

[1] D. F. J. Kimball et al. "Overview of the Cosmic Axion Spin Precession Experiment (CASPER)". In: *Microwave Cavities and Detectors for Axion Research*. Cham: Springer International Publishing, 2020, pp. 105-121. ISBN: 978-3-030-43761-9

[2] Graham, Peter W., and Surjeet Rajendran. "New observables for direct detection of axion dark matter." *Physical Review D* 88.3 (2013): 035023. DOI: 10.1103/PhysRevD.88.035023.

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