

Commissioning of Detection System for the Cosmic Axion Spin Precession Experiment (CASPER)

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CASPER-Gradient searches for axion-like particles (ALP) which are a potential dark matter candidate [1]. The gradient of the ALP field is predicted to resemble a magnetic field in its coupling to nuclear spins [2]. Therefore, a nuclear magnetic resonance (NMR) experiment is adopted to measure such a gradient.

The NMR detection system has been commissioned for this research. We performed a 10-hr measurement with thermally-polarized liquid methanol sample with a 25 ppm homogeneity at the 317 G leading field, which corresponds to searching for an ALP field at 1.349 533 MHz with 34 Hz bandwidth. Noise and ALP coupling constant exclusion are analyzed for the measurement.

References

- [1] Derek F. Jackson Kimball et al. “Overview of the Cosmic Axion Spin Precession Experiment (CASPER)”. In: *Microwave Cavities and Detectors for Axion Research*. Ed. by Gianpaolo Carosi and Gray Rybka. Cham: Springer International Publishing, 2020, pp. 105–121. isbn: 978-3-030-43761-9.
- [2] Peter W. Graham and Surjeet Rajendran. “New observables for direct detection of axion dark matter”. In: *Phys. Rev. D* 88 (3 Aug. 2013), p. 035023. doi: 10.1103/PhysRevD.88.035023. url: <https://link.aps.org/doi/10.1103/PhysRevD.88.035023>.

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