

Production of hyperpolarized xenon-129 for the Cosmic Axion Spin Precession Experiment (CASPER)

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CASPER-Gradient is an nuclear magnetic resonance (NMR) experiment seeking to detect axion-like-particles that could make up the dark matter present in the universe [1]. The detection is based on the coupling of the pseudoscalar dark matter field to nuclear spins. The strength of an NMR signal is proportional to the polarization of the sample. We can define the polarization as the relative difference in population between states of the system.

In this talk, we present the spin-exchange optical pumping procedure [2] that is applied to hyperpolarize xenon. With this technique the polarization is increased significant compared to a thermally polarized sample determined by the Boltzmann distribution. The optimization of the polarization as well as improvements to the setup will be discussed.

References

[1] Jackson Kimball, Derek F., S. Afach, D. Aybas, J. W. Blanchard, D. Budker, G. Centers, M. Engler, et al. "Overview of the Cosmic Axion Spin Precession Experiment (CASPER)." In *Microwave Cavities and Detectors for Axion Research*, edited by Gianpaolo Carosi and Gray Rybka, 105–21. Springer Proceedings in Physics. Cham: Springer International Publishing, 2020. https://doi.org/10.1007/978-3-030-43761-9_13

[2] W. Happer and W. A. Van Wijngaarden. "An optical pumping primer". In: *Hyperfine Interactions* 38.1-4 (1987), pp. 435–470. ISSN : 03043843. DOI : 10.1007/BF02394855 .

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