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Searching for axion-like dark matter with ensembles of nuclear spins

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Nuclear magnetic resonance is one of the promising approaches in searching for axion-like dark matter. We report the first science results of the CASPER-electric search for the EDM and the gradient couplings of axion-like dark matter to nuclear spins in the mass range of 162 neV to 166 neV. The experiment employs an ensemble of ^{207}Pb nuclear spins inside a polarized ferroelectric solid PMN-PT crystal. We also demonstrate how the relaxation properties of this spin ensemble can be controlled using transient light-induced paramagnetic centers. Such spin ensemble engineering is necessary to achieve the sensitivity at the level of the QCD axion EDM coupling in the kHz to MHz frequency band.

Primary author: Ms AYBAS, Deniz (Boston University)

Presenter: Ms AYBAS, Deniz (Boston University)

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