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Status of the Cosmic Axion Spin Precession Experiment

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First proposed to solve the strong CP problem, axions are also plausible candidates for dark matter as they are expected to have a mass and as they have seemingly weak interactions with known particles. The Cosmic Axion Spin Precession Experiment (CASPER) encompasses multiple projects using nuclear magnetic resonance (NMR) to search for axion dark matter. The CASPER-Gradient Low Field (LF) and High Field (HF) apparatuses investigate the interaction between nuclear spins and the gradient of the axion classical field oscillating at the Compton frequency $m_a c^2 / \hbar$. The two instruments use superconducting magnets generating up to 0.1 T and 14.1 T and detect the axion-induced nuclear precession thanks to respectively a superconducting quantum interference device (SQUID) and a tunable LC circuit allowing in principle detection in the 1 kHz to 4 MHz and 1 kHz to 600 MHz mass range. Here, we present the current status of the CASPER-Gradient experiments, including the recent commissioning measurement of the CASPER-LF setup and the characterization of the newly-built CASPER-HF as well as progress toward the use of a hyperpolarized ^{129}Xe sample. These efforts constitute an important step toward the exploration of uncharted regions of the axion dark matter parameter space.

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