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ADMX-VERA: A large volume haloscope for higher axion frequencies

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Axions, which provide a solution to the strong CP problem, are one of the most prominent candidates for dark matter. The axion parameter space spans many orders of magnitude in mass, and a variety of search techniques will be needed to cover such a wide range. Haloscopes look for axion-photon conversion in a magnetic field, but they face the challenge of being smaller in volume as the axion mass and its corresponding frequency increases. This reduction in volume scales linearly to the expected axion signal power. The ADMX-VERA (Volume Enhanced Resonant Axion) experiment is a pathfinder experiment that targets axions in the higher frequency range of 4 - 32 GHz and addresses the volume issue with a tunable “shell cavity” concept which can access the high frequency resonant modes without significantly sacrificing the volume. We discuss quantum sensing techniques that will be deployed with ADMX-VERA, as well as the shell cavity design. Finally, we describe a unique feature of the readout, which uses microwave slot antennas that are coherently added through an impedance-matching summing tree structure.

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