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Tuning microwave cavities with biased nonlinear dielectrics for axion searches

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The axion is a proposed solution to the strong CP problem and is a dark matter candidate. The search for dark matter axions may be aided by haloscopes: tunable, passive, high-Q microwave resonators, placed inside multi-tesla magnetic fields and operating at cryogenic temperatures. (The Axion Dark Matter eXperiment, ADMX, is an example of this technique.) In the presence of strong B-fields, axions may couple to two photons, which in turn may be detected through the resonant excitation of the high-Q microwave cavity and subsequent low-noise amplification and readout. There are points of common interest, then, between experiments like ADMX and the particle accelerator technology community. We discuss one such point here. Axion searches above ~ 1 GHz will employ multiple resonators locked to the same frequency. Fine tuning of individual resonators may be accomplished using thin films of strontium titanate (STO) and related materials, whose dielectric strength can be varied through DC voltage bias.

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