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The Axion Longitudinal Plasma HALoscope (ALPHA)

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The axion is a well-motivated dark matter candidate with an extensive range of mass unexplored experimentally. New string production models for the post-inflation QCD axion predict higher axion masses than we have explored with modern haloscopes. While traditional tunable cavity-based haloscopes have proven exquisitely sensitive at lower frequencies, their sensitivity drops off at higher frequencies due to decreasing cavity volume. The Axion Longitudinal Plasma HALoscope (ALPHA) overcomes these limitations by constructing metamaterial resonators operating in the 10-100 GHz frequency range with no volume constraints. I will present the status of the first phase of the ALPHA haloscope sited at Yale. The Yale site will operate a cavity in the 10-20 GHz range in a 14-16 Tesla magnetic field at mK temperatures, with a readout using quantum-limited parametric amplifiers. The ALPHA haloscope at Yale is targeting 1) a demonstration of improved sensitivity operation of metamaterial resonators in a high-field, large-bore magnet and 2) KSVZ limited constraints on the axion coupling over the 40-80 μeV mass range.

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