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Status and the Future of HAYSTAC: Quantum Enhancement of a Dark Matter Axion Search[1] MARIA SIMANOVSKAIA, UC Berkeley, HAYSTAC COLLABORATION — Dark matter axions may be detected by their resonant conversion to photons in a tunable microwave cavity permeated by a strong magnetic field. The Haloscope at Yale Sensitive To Axion Cold dark matter (HAYSTAC) is the first such axion cavity detector to incorporate a dilution refrigerator and Josephson parametric amplifier and thereby achieve near-quantum-limited noise performance. Last year, first results from HAYSTAC excluded axion models a factor of $\sim$2.3 above the benchmark KSVZ model over the mass range 23.55 μeV $< m_a <$ 24.0 μeV. These are the first limits within the axion model band in the 10-100 μeV mass decade. As both a test-bed for innovative cavity and amplifier concepts and a data pathfinder, HAYSTAC is constantly pushing the sensitivity limits and achievable frequency ranges of axion cavity detectors. I will discuss the current state of HAYSTAC and our ongoing research and development work including novel cavity designs and incorporation of recent developments in quantum measurement technology to circumvent the standard quantum limit, thus greatly improving the search rate and sensitivity of the experiment.

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