

New Windows on Fundamental Physics: from tabletop devices to large scale detectors



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Dark Matter Axion Search with the HAYSTAC and ALPHA Experiment

Monday, 19 January 2026 13:30 (30 minutes)

Axions are well-motivated dark matter candidates originally proposed to resolve the strong CP problem in quantum chromodynamics. In this talk, I present recent results from the Haloscope At Yale Sensitive To Axion Cold Dark Matter (HAYSTAC) experiment, which searches for axion dark matter using a tunable microwave cavity coupled to a quantum squeezed state receiver. HAYSTAC has scanned axion masses between 16.96–19.46 μeV , finding no statistically significant signal and excluding axion–photon couplings down to $|g_\gamma| \geq (2.86) \times |g_\gamma^{\text{KSVZ}}|$ at 90% confidence. This result achieves a scan rate enhancement of up to a factor of 2 compared with an equivalent quantum-limited search, demonstrating the efficacy of the squeezed state receiver over a substantial mass range. I will also discuss the Axion Longitudinal Plasma Haloscope (ALPHA) experiment, which employs metamaterial resonators to overcome volume limitations of traditional cavity haloscopes and enable axion searches at higher frequencies, and present the current status of ALPHA.

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