APR21-2021-001256
E

Abstract for an Invited Paper
for the APR21 Meeting of
the American Physical Society

A Quantum-Enhanced Search for Dark Matter Axions[1]

KELLY BACKES, Yale University, HAYSTAC COLLABORATION

Almost a century after the dark matter problem was first posed, dark matter's minute experimental signature continues to elude direct detection. One hypothetical solution to this problem is the axion, a tiny particle of unknown mass and interaction strength that must be sought by scanning through frequency space. Quantum noise fundamentally limits the rate of this search. The Haloscope at Yale Sensitive to Axion Cold dark matter (HAYSTAC) [1] has now overcome this limit by using Josephson parametric amplifiers to manipulate squeezed quantum states [2], accelerating the search for axions by a factor of two. In this talk, I will discuss the use of squeezed quantum states to reduce detector noise to below the standard quantum limit and HAYSTACs newly published limit on axion parameter space [3]. These results demonstrate an unprecedented sub-quantum-limited search for new fundamental particles. [1] B. M. Brubaker et al, First Results from a Microwave Cavity Axion Search at 24 eV, Phys. Rev. Lett. 118, 061392 (2017). [2] M. Malnou, D. A. Palken, B. M. Brubaker, Leila R. Vale, Gene C. Hilton, and K. W. Lehnert, Squeezed Vacuum Used to Accelerate the Search for a Weak Classical Signal, Phys. Rev. X 9, 021023 (2019). [3] K. M. Backes et al. A quantum-enhanced search for dark mat

[1]Supported by NSF grants PHY-1362305, PHY-1701396, PHY-1607223, and PHY-1607417, the Heising-Simons Foundation under grants 2014-181, 2014-182, and 2014-183, Yale University, and Yale Wright Laboratory.