Abstract Submitted
for the APR16 Meeting of
The American Physical Society

Enhancing the ADMX-HF Search Rate via Quantum Squeezing
DANIEL PALKEN, MAXIME MALNOU, KONRAD LEHNERT, JILA, University of Colorado, Boulder, Colorado 80309, USA — ADMX-HF seeks to detect dark matter axions in the 4-12 GHz band by reading out the state of a microwave cavity [1]. Utilizing a quantum-limited, phase-insensitive amplifier such as a Josephson Parametric Amplifier (JPA) [2] to read out both quadratures of the putative axion signal adds a full quantum of noise atop that signal. The two halves of that quantum are attributed to the noncommutation of the quadrature operators with the cavity Hamiltonian and with one another. We propose a method whereby both halves of this quantum may be circumvented. A JPA is used to create a squeezed microwave state and inject it into the axion cavity, whereupon an axion field, if present, displaces the squeezed state in phase space. The squeezed state then decays out of the cavity, and a second JPA is used for a phase-sensitive readout of only the squeezed quadrature of the field. A single quadrature measurement need not add noise [3], and, because the cavity field will be prepared in an approximate eigenstate of one quadrature operator, and not of its Hamiltonian, that half-quantum is averted as well. The limiting factor in this protocol will be the efficient transport of the squeezed microwave state between the JPAs and the axion cavity. We estimate that with currently achievable efficiency, we can increase the axion search rate by a factor of four. \pard[1] T.M. Shokair et al., Int. J. Mod. Phys. A 29, 144304 (2014). 2] M.A. Castellanos-Beltran and K.W. Lehnert, Appl. Phys. Lett. 91, 083509 (2007). 3] C.M. Caves, Phys. Ref. D 26, 1817 (1982).

Daniel Palken
JILA, University of Colorado, Boulder, Colorado 80309, USA

Date submitted: 10 Jan 2016 Electronic form version 1.4