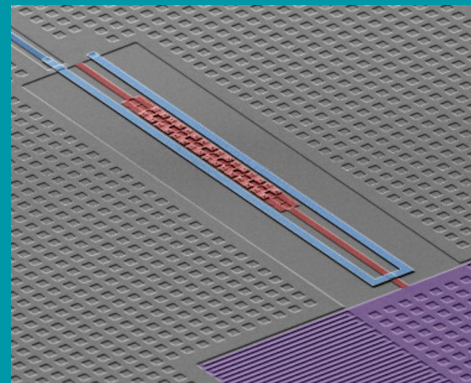




Quantum Sensors for Axion Detection with the Haloscope at Yale Sensitive to Axion CDM (HAYSTAC)



Danielle Speller and Kelly Backes for HAYSTAC-Yale
February 19, 2019

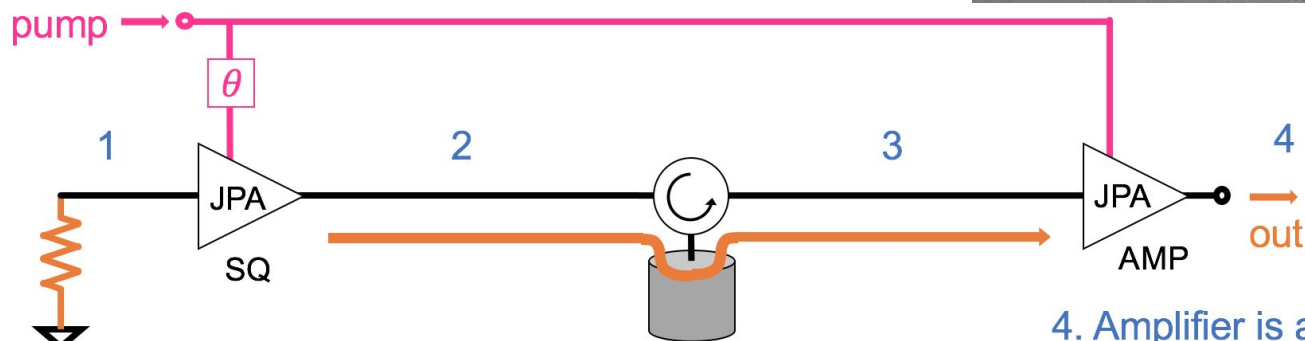
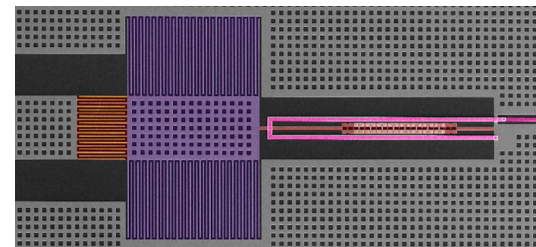
Yale



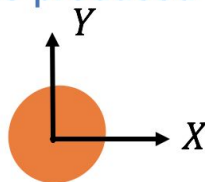
Wright
Laboratory

HAYSTAC 

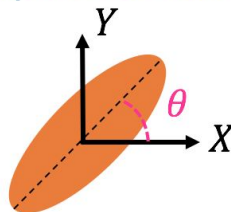
Quantum Sensors in HAYSTAC



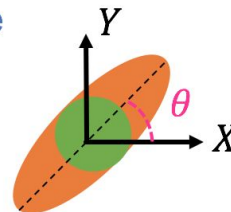
1. Coherent state produced



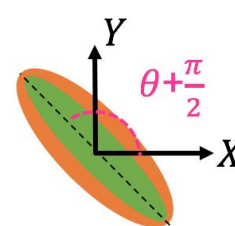
2. Squeezer produces squeezed state



3. Cavity adds coherent noise



4. Amplifier is anti-aligned with squeezer. Cavity noise amplified



Next Generation Quantum Sensors in Axion Detection

Moving upward in frequency requires a different detection scheme

- Counting experiment allows us to escape the phase sensitive detection generally subject to the SQL

First stage: Establish Rydberg beam, and conduct EIT on our potassium beam.

Second stage: Selective field ionization of Rydberg atoms.

Future: Incorporate quantum non-demolition techniques

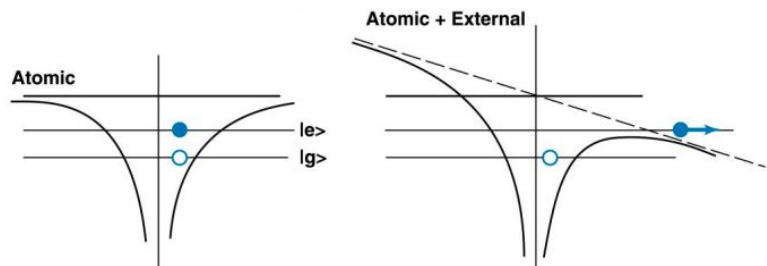


Figure: Bradley et. al. Rev. Mod. Phys., Vol. 75, No. 3 (2003)



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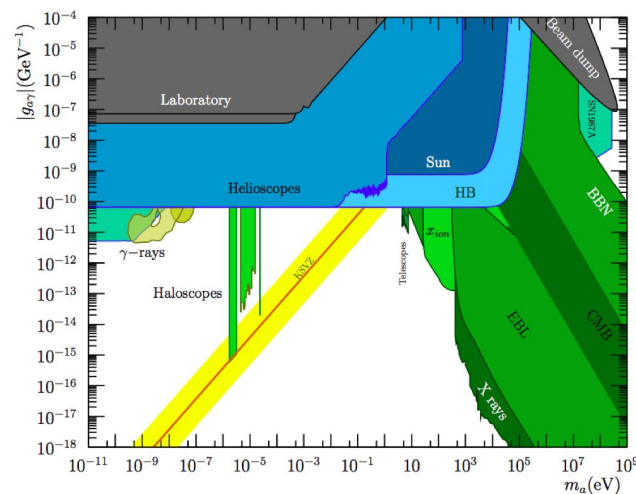
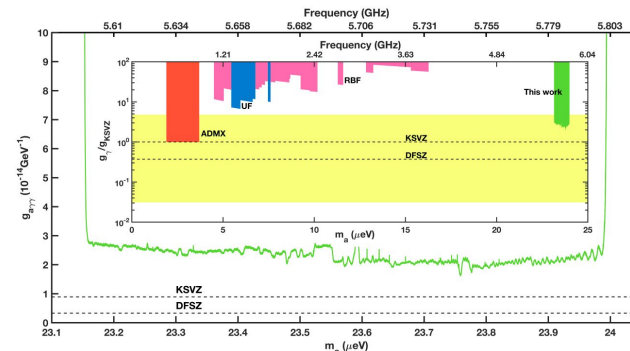


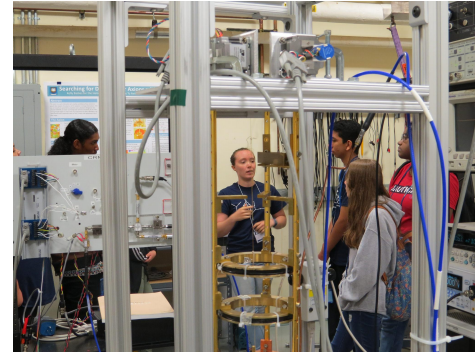
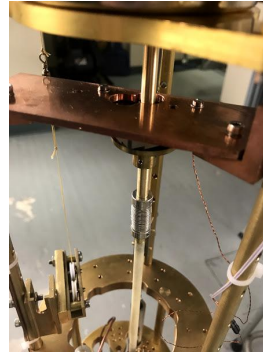
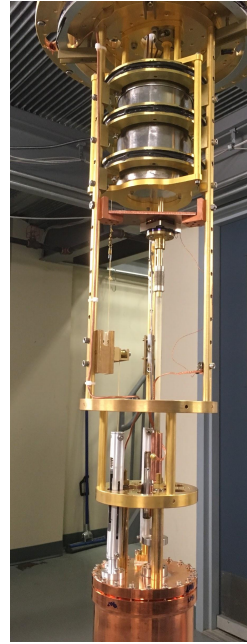
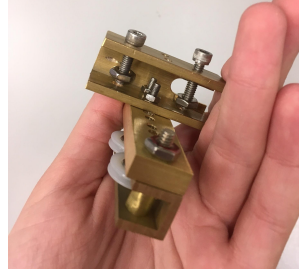
Image Credit: I. G. Irastorza and J. Redondo, arXiv:1801.08127v1

Quantum Sensors and Axion Detection and Yale

Facilities: Lab space, machine shop, rapid prototyping, device fabrication

Collaboration: Expertise in photon counting at YQI, more lunches, discussions, sharing/general ideas

Outreach: Public communications, scientific outreach, managed REU program



Accelerating dark-matter axion searches with quantum measurement technology

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