

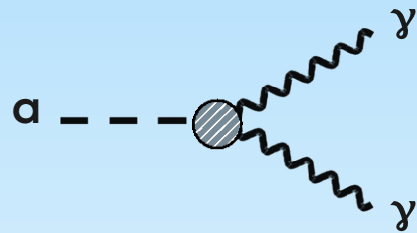
# Overview of Axion Search Techniques

Gray Rybka  
Vistas in Axion Physics  
Seattle, Washington  
April, 2012

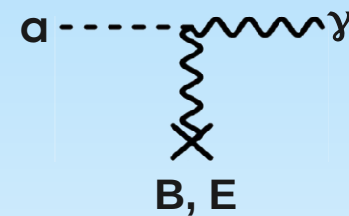
# Axion Parameterization

While  $f_a$  is the fundamental parameter of the axion, the experimentally accessible parameters are axion mass and couplings

Couplings to photons are particularly interesting



axion-photon coupling  $g_{a\gamma\gamma}$

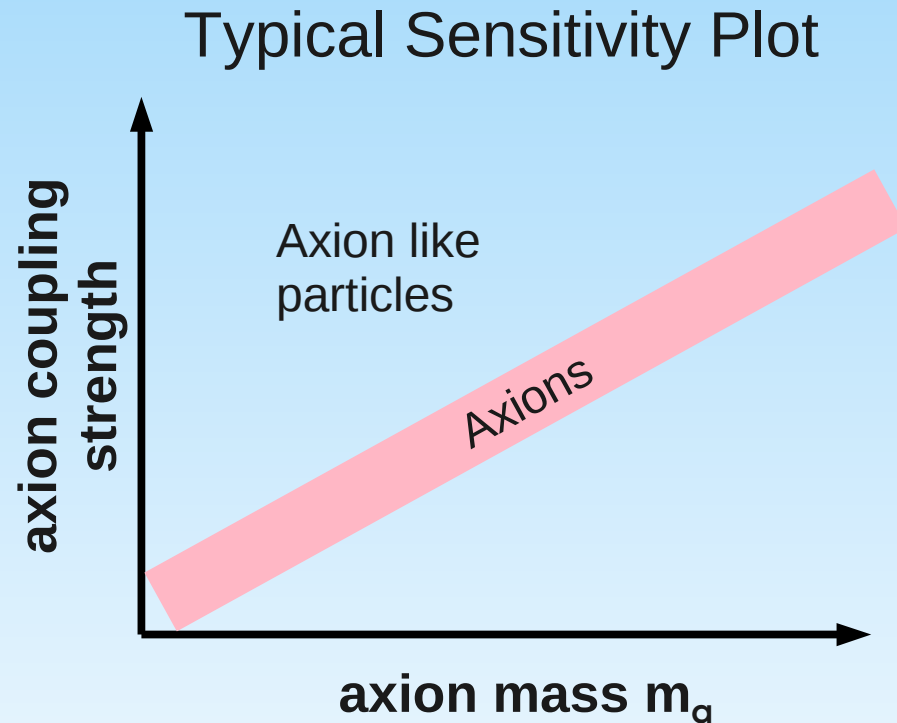


Primakoff process

Many axion experiments rely on the Primakoff process

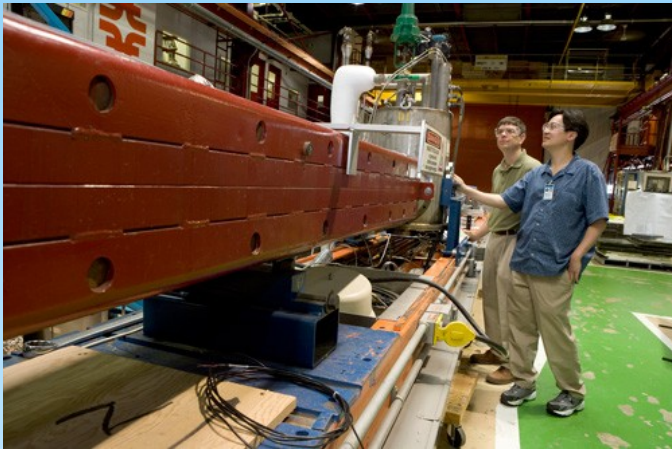
# Axions & Axion Like Particles

Axion mass and coupling are related for QCD axions



But axion like particles with different masses and couplings could exist

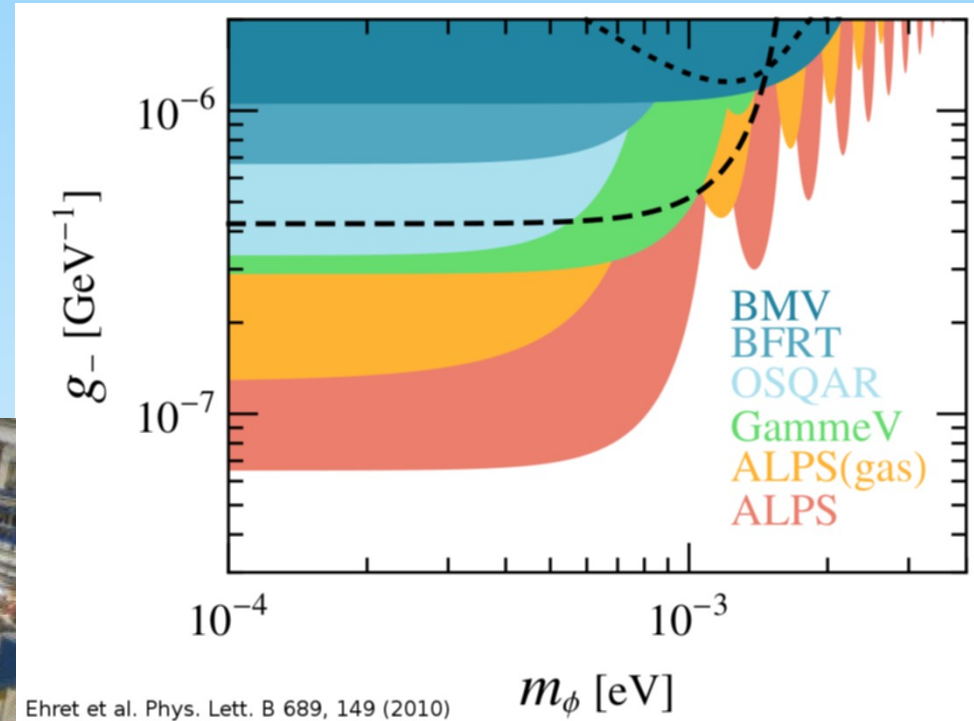
# Light Shining Through Walls



GammeV experiment

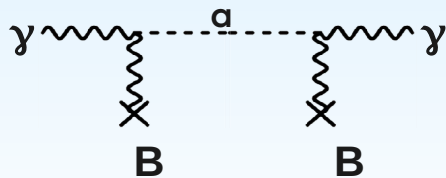


ALPs experiment



LSW experiments explore couplings as low as  $10^{-7} \text{ GeV}^{-1}$  and masses up to meV

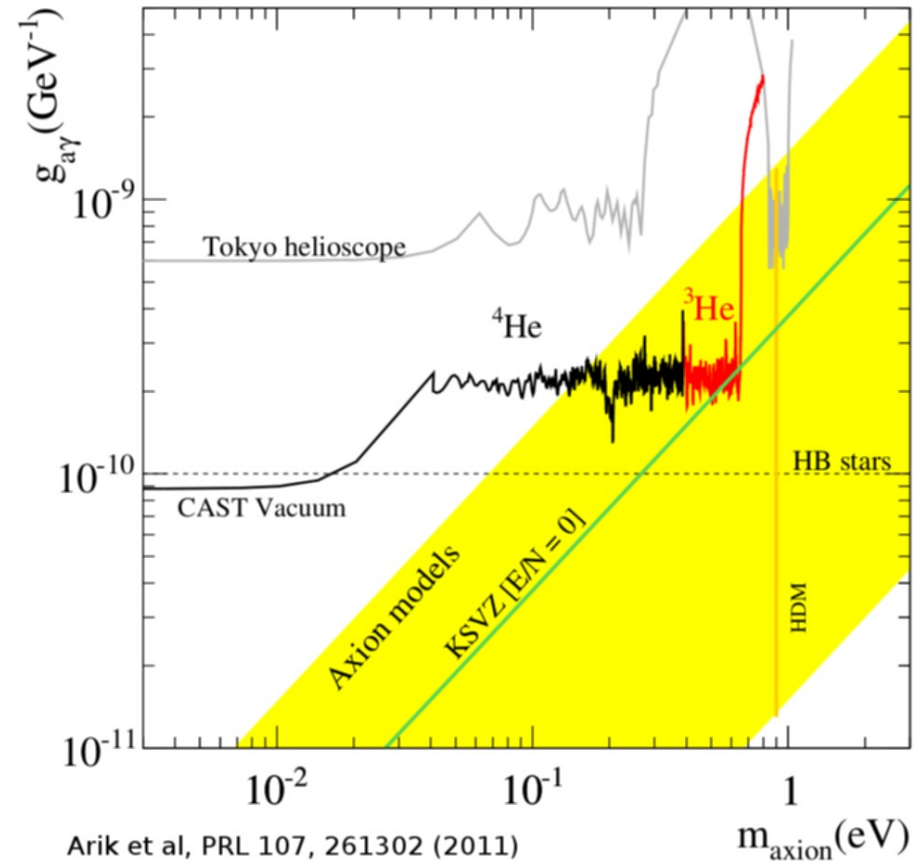
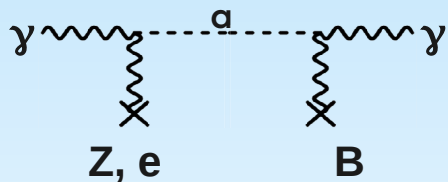
Photon polarization experiments: same principle, different signal



# Axions from the Sun

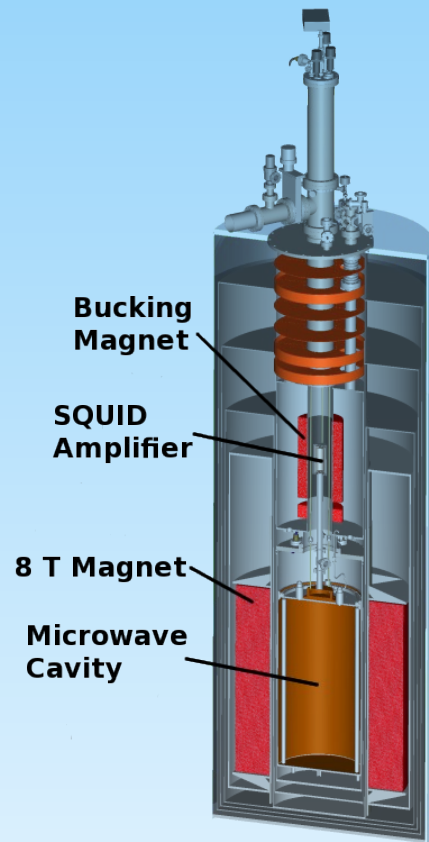
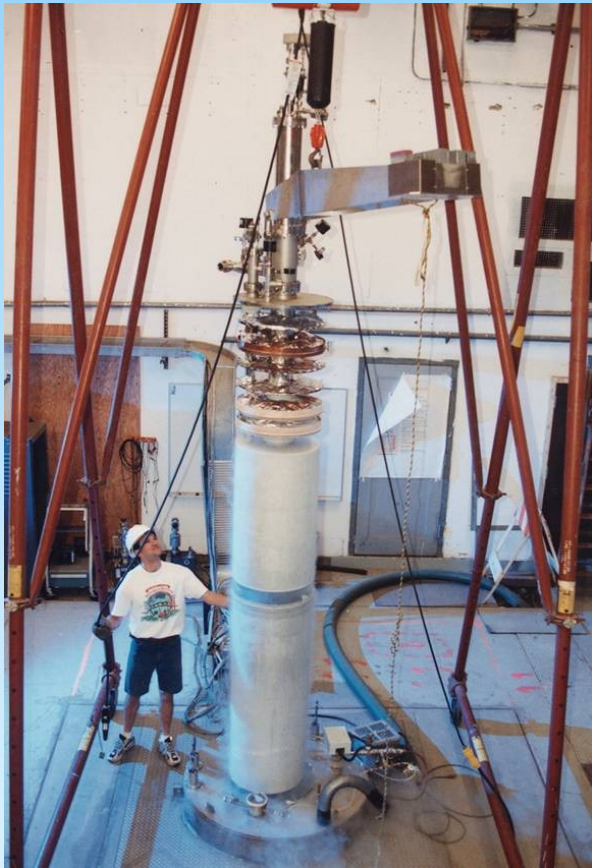


CAST Experiment

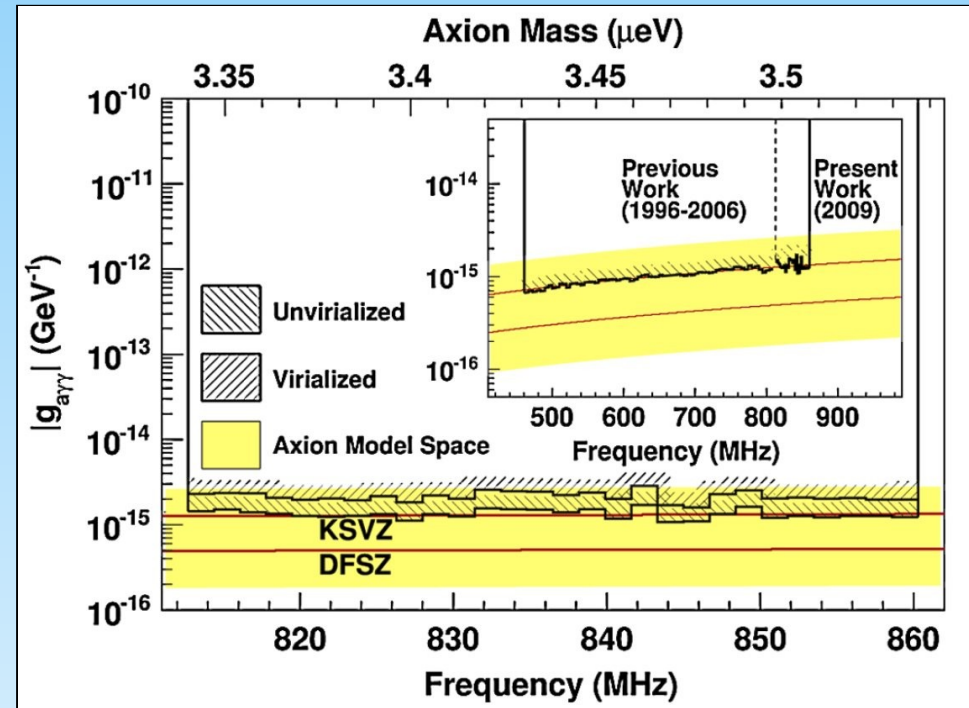


Solar telescopes explore axion photon couplings around  $10^{-10}$  GeV<sup>-1</sup> and masses up to  $\sim 1$ eV

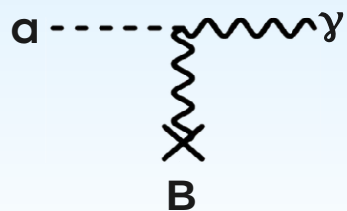
# Axions as Dark Matter



ADMX experiment



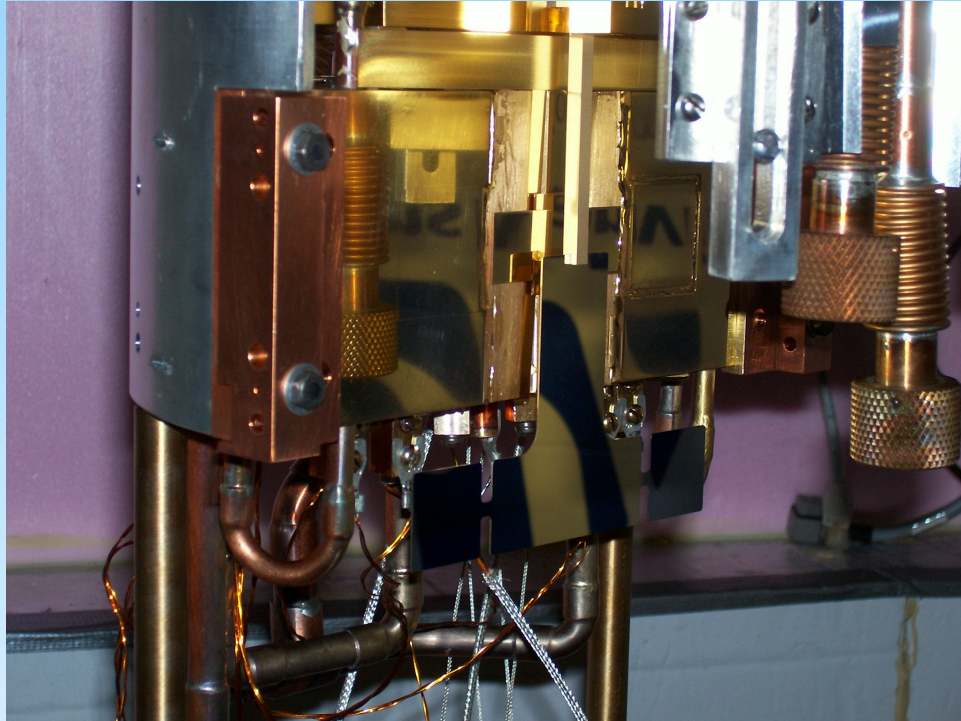
Asztalos et al. PRL 104, 041301 (2009)



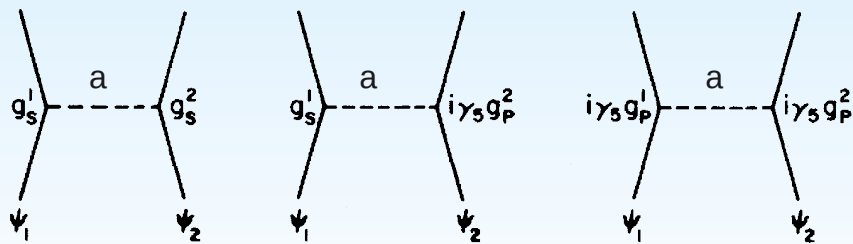
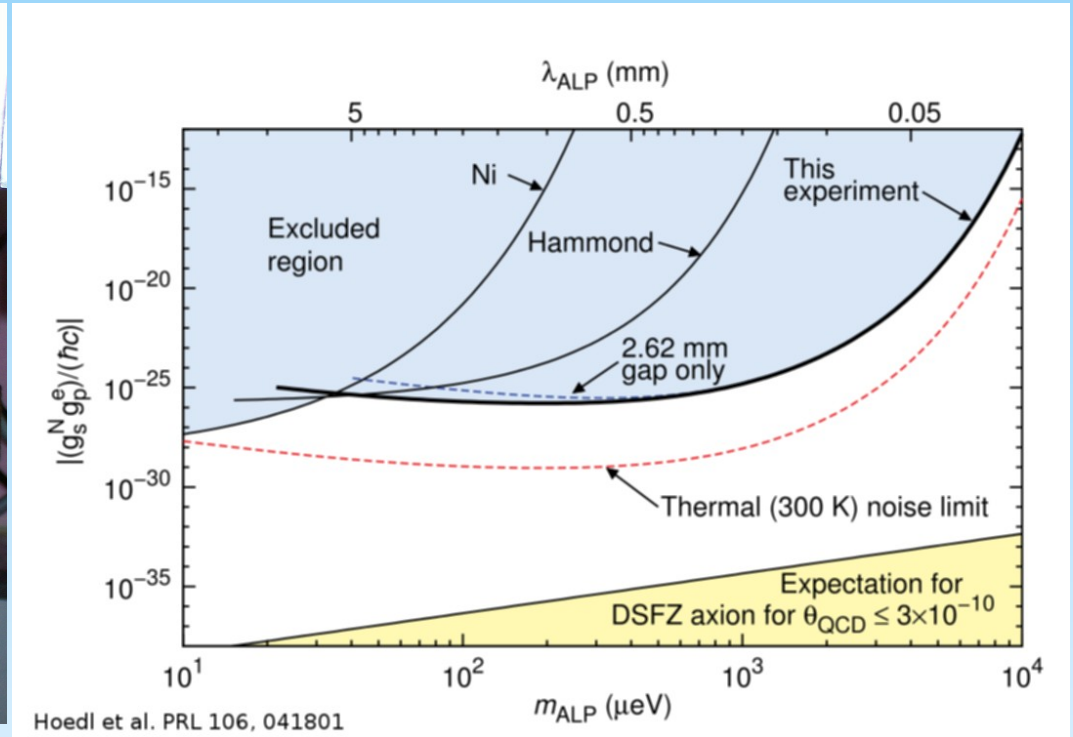
Cavity experiments are sensitive to axions in the range  $1 \mu\text{eV} - 100 \mu\text{eV}$ , where they could make up much of the dark matter of the universe. Couplings are  $\sim 10^{-15} \text{GeV}^{-1}$



# 5<sup>th</sup> Force Experiments



Eöt-Wash Group



Moody & Wilczek, 1984

Axions behave as force carriers, and could be detected as a short range deviation from gravity

# Additional Searches

Many search techniques have been omitted due to time constraints

I hope to hear some new techniques at this workshop

- Astrophysical Measurements
  - Stellar Lifetime
  - Supernovae
  - Neutron star cooling
- Beyond horizon fluctuations
- Time varying CP violation
- Neutron spin precession
- Magnetometers
- Germanium crystals



# Axion Search Big Picture

