Quantum Sensing for the Axion Plasma Haloscope

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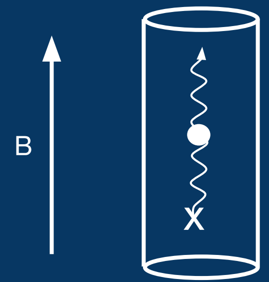
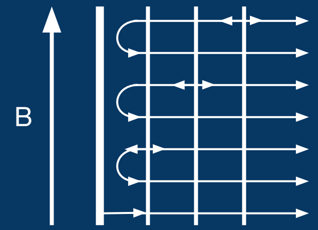
Plasma Haloscopes

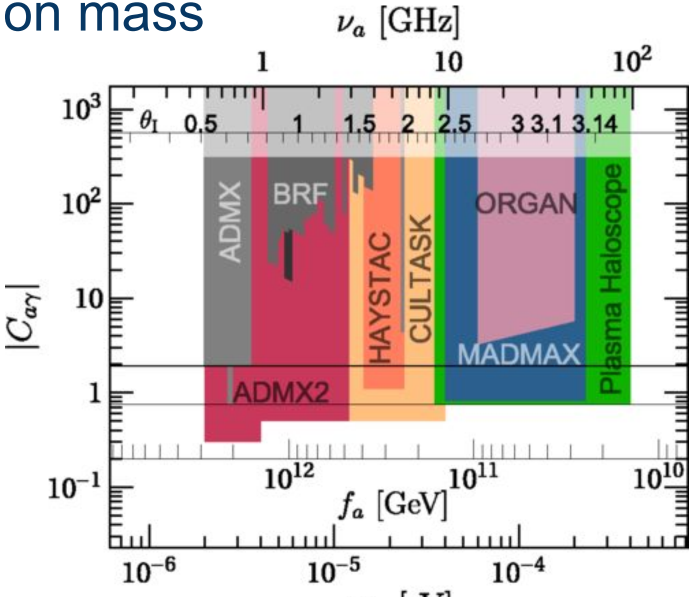
Cavity Haloscopes



Dielectric Haloscopes



- Traditional haloscopes alter photon wave function with structures on Compton scale
- Plasma haloscopes tune photon mass (plasma frequency) to match axion mass
- Decouples volume of haloscope from axion mass



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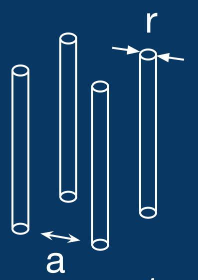
Plasma Target Material

Wire metamaterials

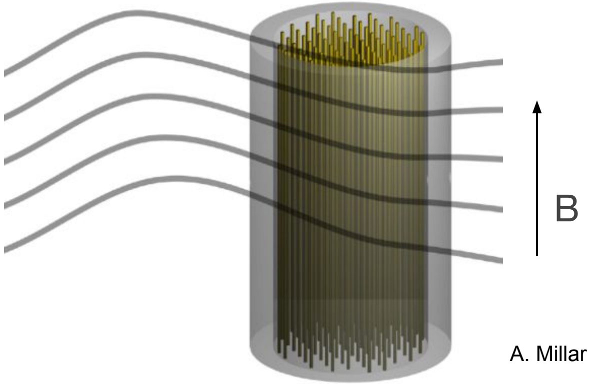


$$\omega_p^2 \propto \frac{1}{a^2 \log(a/r)}$$

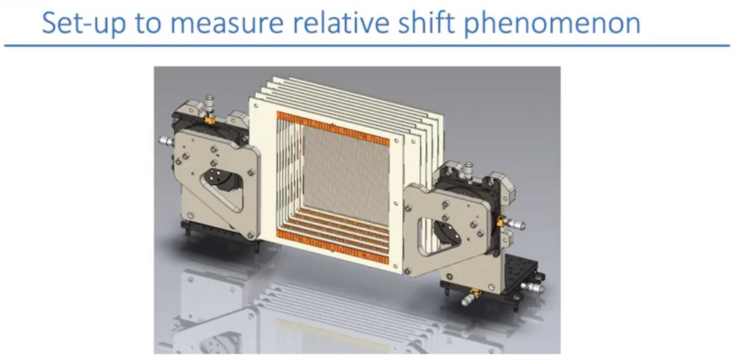
Semiconductors

$$\omega_p^2 \propto \text{Carrier density}$$

- Wire metamaterials
  - tune plasma frequency with interwire spacing



A. Millar



S. Al Kenany @ van Bibber group

- Semiconductors (InSb, Si, Ge)
  - tune plasma frequency w/ T, B, dynamic doping with light

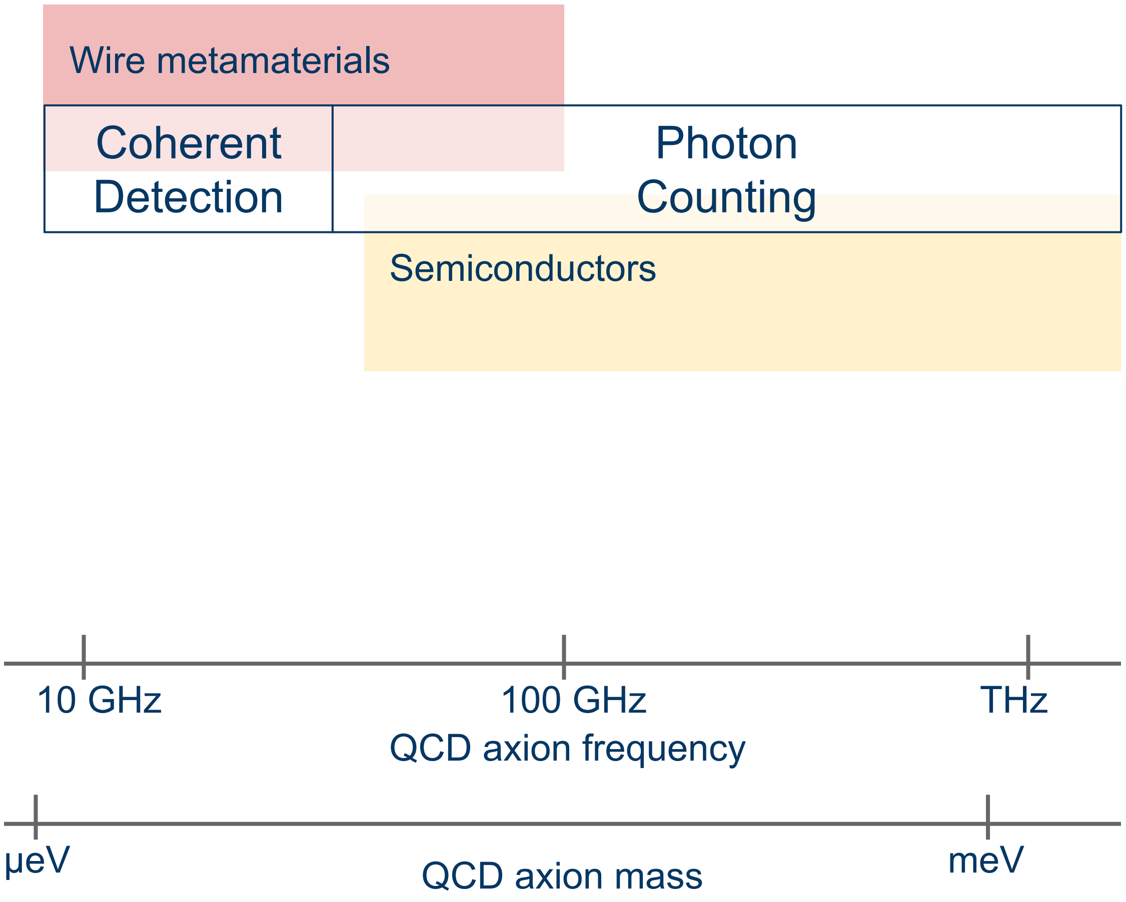
Coherent Detection

- Summing network of dipole antennas + LNA

Photon Counting

- Allow plasmons to decay to photons

Detection Regimes



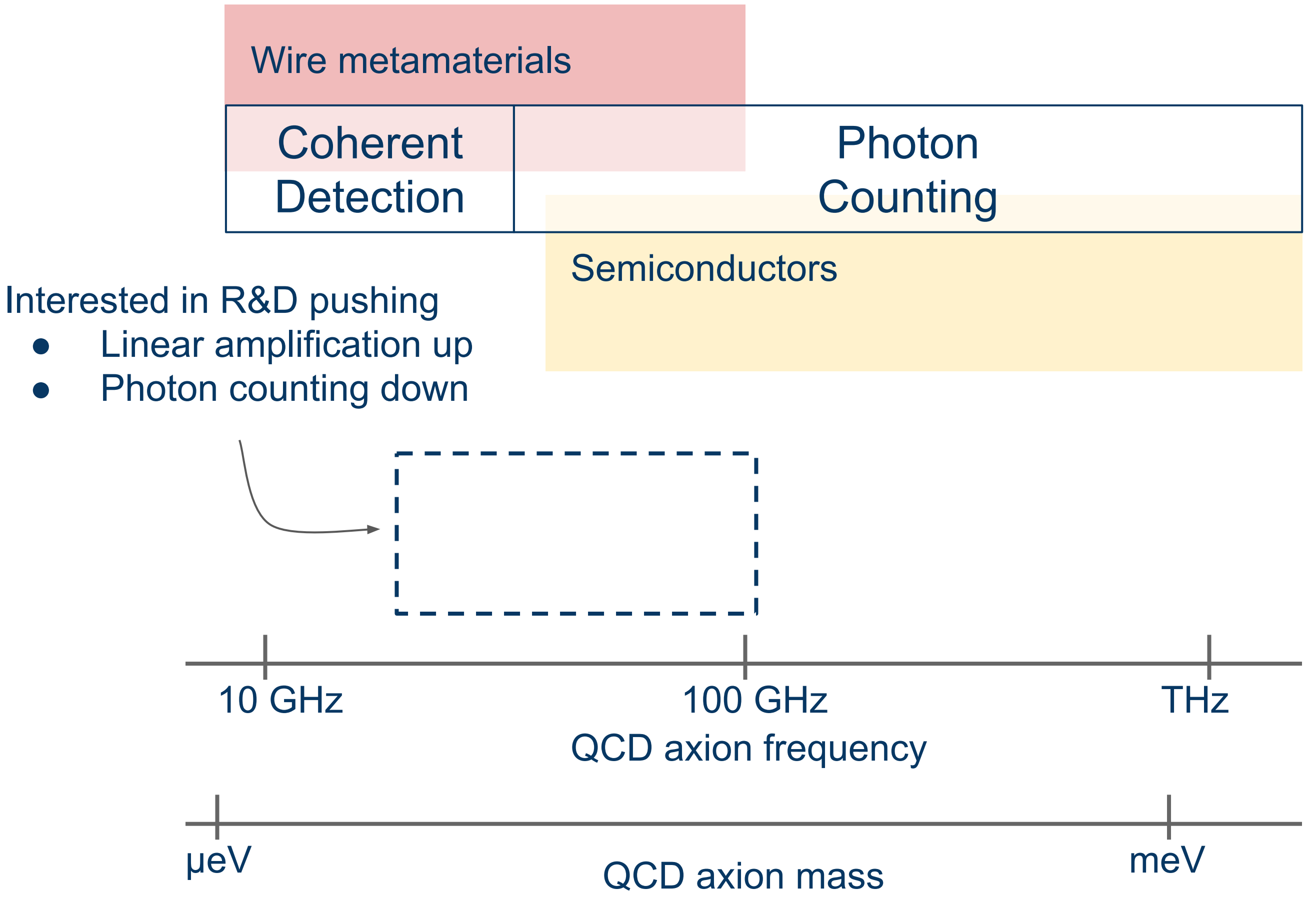
High-frequency Linear Amplifiers

- Squeezed states

Low-threshold MKIDs/TESs

- Low (reduced) Tc materials

Detection Regimes



- LoI submitted to
  - CF2 Dark Matter: wave-like
  - IF1 Quantum Sensors
  - IF2 Photon Detectors
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