UWA microwave cavity hidden sector photon search
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1 Goal of experiment

The goal of this experiment is to search for, and place limits on, hidden sector photons in the region of $m_{\gamma\prime}$-χ parameter space accessible to microwaves.

2 Experimental setup

Microwave cavity light-shining-through-a-wall experiments [1] consists of two microwave cavities separated by ample shielding. A signal is sent into one cavity whilst a detector is placed on the other. In the presence of hidden sector photons theres is a small transmission probability between the cavities. Photons in the emitter cavity can oscillate into hidden sector photons, traverse the barrier, and then oscillate back into photons in the detector cavity.

The next planned iteration of this experiment at UWA [2,3] will use a superconducting niobium cavity ($Q \sim 10^8$) in a cryo-cooler alongside a room temperature copper cavity ($Q \sim 10^4$) in vacuum. Both cavities are cylindrical and approximately 4 cm in size. The system will operate in the TM_{020} resonance mode at a frequency of 12.595 GHz, thus probing the hidden sector photon of mass 52.1 μeV. Figure 1 gives a schematic of the setup.

3 Accelerator or Lab Facility

As a small scale experiment, it will be run in one of the physics cryogenic labs at the University of Western Australia.

4 Physics Reach

Given the conditions outlined above, a geometric factor of $|\mathcal{G}| \approx 0.28$ ($\mathcal{F}^2 \approx 37000$) should be achievable. This gives a peak sensitivity to the kinetic mixing factor $\chi \sim 1.8 \times 10^{-8}$. A full plot of the projected limit is given in Fig. 2.

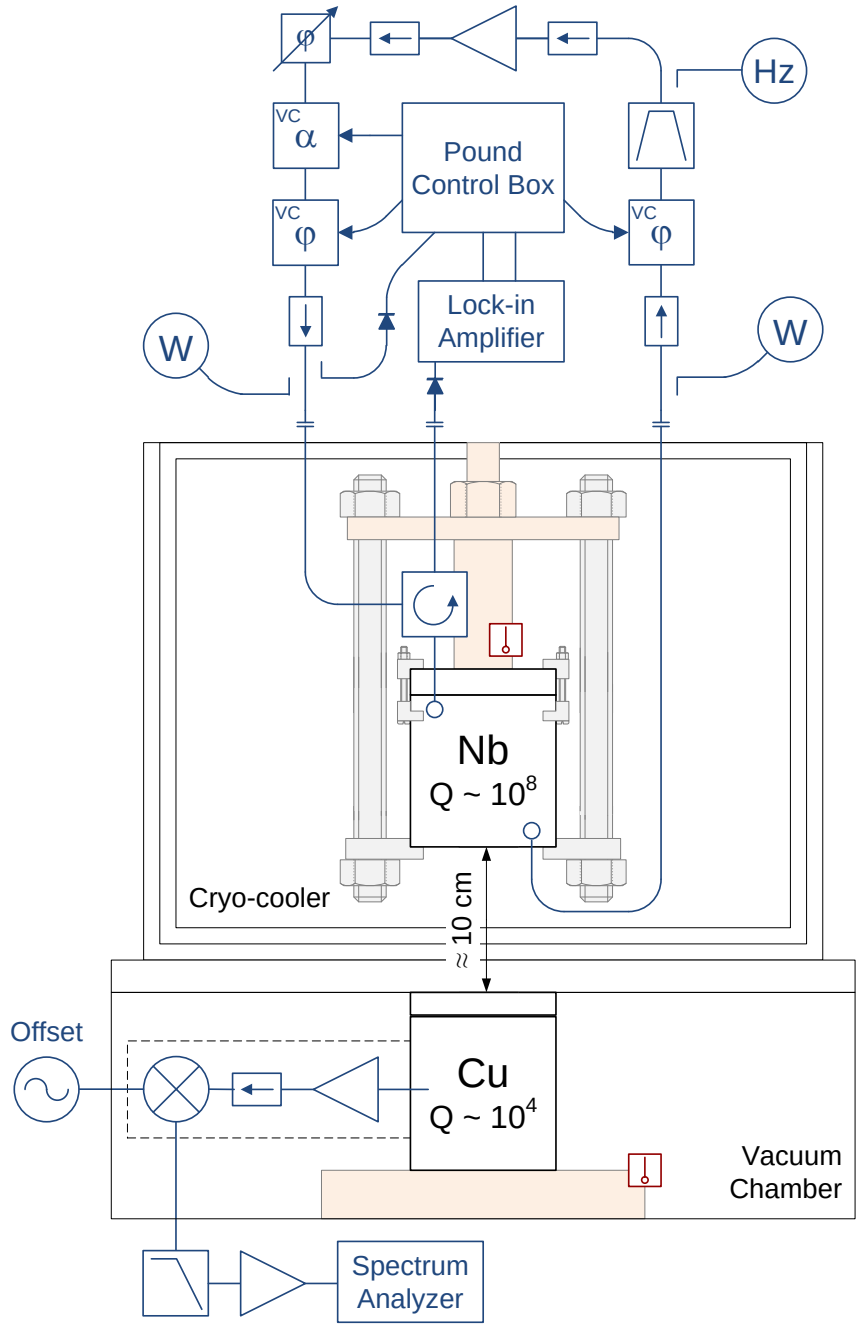

Figure 1: Diagram of the new UWA microwave cavity light shining through a wall experiment.

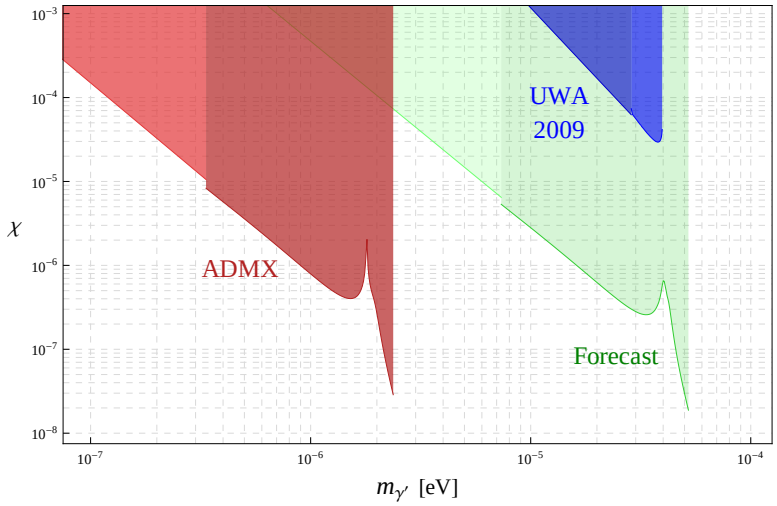

Figure 2: Plot of the predicted hidden sector photon limit from the new experiment against limits established by other microwave experiments.

Future experiments after the next iteration may try to push these values further.

5 Status and Schedule

This iteration of the experiment is currently planned to take place in 2012. The required equipment has already been obtained.

6 Future Plans

Numerous ideas for future experiments are in development. Most revolve on alternative techniques to infer a hidden sector photon presence. Upgrades to equipment, namely higher Q cavities, may also be possible.

7 Collaborating Institutions and Collaborators

The University of Western Australia (UWA): John Hartnett, Rhys Povey, Michael Tobar

8 Written Materials

[1] J. Jaeckel and A. Ringwald, *Phys. Lett. B* **659** (2008) 509-514.

[2] R. G. Povey, J. G. Hartnett, and M. E. Tobar, *Phys. Rev. D* **82** (2010) 052003.

[3] Brief presentation on the new experiment to be published in the *7th Patras workshop on Axions, WIMPs and WISPs* 2011 proceedings.