

Snowmass2021 - Letter of Interest

[Coordination between Axion Haloscope Experiments]

Thematic Areas: (check all that apply /■)

- (CF1) Dark Matter: Particle Like
- (CF2) Dark Matter: Wavelike
- (CF3) Dark Matter: Cosmic Probes
- (CF4) Dark Energy and Cosmic Acceleration: The Modern Universe
- (CF5) Dark Energy and Cosmic Acceleration: Cosmic Dawn and Before
- (CF6) Dark Energy and Cosmic Acceleration: Complementarity of Probes and New Facilities
- (CF7) Cosmic Probes of Fundamental Physics
- (Other) *[Please specify frontier/topical group]*

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Abstract: Several ways that Axion Haloscopes can coordinate their efforts are suggested.

The case for the QCD axion as dark matter is as compelling as ever. While recent Axion Haloscope experiments have shown that even the DFSZ model of axions can be explored over select frequencies, the theoretical range of plausible frequencies to search is broad. It is likely that the range of frequencies will be explored by multiple instruments, possibly operated remotely, and possibly operated by multiple collaborations. It is in the community's best interest to coordinate this search efficiently. I submit several techniques for the community to consider.

1 Axion Center

An axion haloscope fundamentally consists of a powerful magnet and a resonant detector. The most centralized way to organize parallel searches is to select a site where many superconducting magnets can be maintained in relatively close proximity. This would concentrate operations expertise and save on maintenance costs. This has already been demonstrated in small scale at the South Korean Center for Axion and Precision Physics. Another option would be a magnet with an enormous volume, subdivided so that multiple independent axion searches can be conducted within it simultaneously. A US national lab would be a natural site for such a center.

2 Interchangeable Detectors

In the event that it is more politically advantageous to operate multiple haloscopes independently, it may be most efficient to use standardized construction, either in the magnets or detector interface. This would save tremendously in experiment engineering costs, and allow detectors to operate in ready magnets as schedules adjust to reflect the reality of detector development. This would require close coordination that would work best within the same scientific collaboration.

3 Inter-Collaboration Committee

If hardware compatibility is untenable, it is still in the community's best interest to cooperate on the axion search on a number of issues. The definition of a signal in analysis methods should be consistent. For the initial search, there should be little overlap in frequency range between searches. There should be a plan for independent verification if a signal is seen. A successful model for this coordination is the Gravitational Wave International Committee, which helped guide the gravitational community to the discovery of gravitational waves. An Axion Search International Committee could play a similar role in coordinating the discovery of axion dark matter.