

# PHYSICS AND ASTRONOMY COLLOQUIUM

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## Ultrasensitive Searches for the Axion

After three decades, the axion, a hypothetical elementary particle, still represents the best solution to the Strong-CP problem, i.e. why the neutron has a vanishingly small electric dipole moment. Should the axion exist, it would be extremely light, in the range between a micro-eV and milli-eV, and possess extraordinarily feeble couplings to matter and radiation, far beyond the reach of conventional particle physics experiments. Very light axions would also have been produced abundantly during the Big Bang, and thus the axion represents a well-motivated dark matter candidate. As recognized by Pierre Sikivie in 1983, the coherent mixing of axions and photons in a strong magnetic field of large spatial extent provides the strategy for elegant and ultrasensitive experiments that may finally render the axion observable. This talk will primarily review the microwave cavity search for halo dark matter axions and present first results from a high-frequency search; but also briefly discuss the search for solar axions, and purely laboratory experiments, such as photon regeneration (“shining light through the wall”). The searched-for signals are nevertheless still extremely small, and thus axion searches have proven to be a driver for technology innovation, such as sub-quantum-limited Josephson Parametric Amplifiers and hybrid superconducting microwave cavities for the dark matter axion experiment.



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