

Dark Matter Search on Chips

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Axions and axion-like particles are well motivated candidates for dark matter (DM) and have a signature two photon vertex. The most sensitive axion DM search is at the gigahertz (GHz) regime. It relies on microwave cavities with high quality factors resonantly converting axion DM to cavity photons in the background of a static magnetic field. However, axion DM mass could span a vast range above or below GHz. We describe a new proposal using integrated/on-chip photonic systems to search for axion DM at the optical frequency. This enables the use of waveguides to collect signal photons, which improves the detection efficiency, as well as the use of single photon, micron-sized detector, such as a skipper charge-coupled device, which has a dark count rate as low as $1e-9$ per second per pixel. Furthermore, by coupling a series of resonators of different frequencies to a single receiver bus, the detection can be broadband in terms of the axion masses and has sensitivities to the axion-photon couplings expected for the QCD axion at the axion masses of around eV.

Author: GAO, Christina

Presenter: GAO, Christina

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