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Axion Dark Matter Detection with CMB Polarization

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In this talk, I will detail two ways to search for low-mass axion dark matter using cosmic microwave background (CMB) polarization measurements. These appear, in particular, to be some of the most promising ways to directly detect fuzzy dark matter. Axion dark matter causes rotation of the polarization of light passing through it. This gives rise to two novel phenomena in the CMB. First, the late-time oscillations of the axion field today cause the CMB polarization to oscillate in phase across the entire sky. Second, the early-time oscillations of the axion field wash out the polarization produced at last-scattering, reducing the polarized fraction (TE and EE power spectra) compared to the standard prediction. Since the axion field is oscillating, the common (static) ‘cosmic birefringence’ search is not appropriate for axion dark matter. These two phenomena can be used to search for axion dark matter at the lighter end of the mass range, with a reach several orders of magnitude beyond current constraints. I will present a limit from the washout effect using existing Planck results, and discuss the significant future discovery potential for CMB detectors searching in particular for the oscillating effect.

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