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Circularly polarized radiation from Axion-Photon conversion and CMB V-mode measurements

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In the presence of a background magnetic field, axions or axion-like particles (ALPs) can be resonantly converted to photons when their mass is nearly equal to the effective photon mass. In this paper, we propose a novel method to constrain the parameter space of ALPs by investigating the resulting imprints of axion-photon conversion in the cosmic microwave background (CMB) observations. We show that a helical magnetic field existing prior to the CMB epoch can generate an excess population of photons carrying net circular polarization due to the axion-photon conversion mechanism.

Consequently, current measurements of the angular power spectrum of circular polarization (V-mode) in the CMB can be used to constrain the parameter space of ALP mass and its coupling to photons.

In the optimistic scenario of a maximally helical magnetic field with strength $\sim \mathrm{nG}$, we find that CLASS observations at $40\,\mathrm{GHz}$ can probe the previously unconstrained regions of axion-photon coupling corresponding to ALP masses in the range $10^{-8} - 10^{-10}\,\mathrm{eV}$.

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