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Cosmic birefringence: searching for parity-violating physics with the CMB polarization

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The cross-correlation between the cosmic microwave background (CMB) E- and B-mode polarization can be used to probe parity-violating physics in the Universe. Parity-violating processes such as a Chern-Simons coupling to axion-like particles or the Faraday rotation induced by primordial magnetic fields are expected to rotate the plane of linear polarization and produce a non-null EB correlation. We commonly refer to that rotation as cosmic birefringence.
Past attempts at measuring isotropic cosmic birefringence tended to be dominated by systematic uncertainties and the limited precision of polarization angle calibration. Recently, a novel methodology has overcome the limitation imposed by the insufficient knowledge of instrument calibration by calibrating against Galactic foreground emission. When applied to Planck and WMAP data, this technique hints at the existence of an isotropic $\beta \approx 0.34^{\circ} \pm 0.09^{\circ}$ birefringence angle. Although it is still under scrutiny for its dependence on the modeling of Galactic dust emission, these results currently exclude $\beta = 0$ with a statistical significance of 3.6σ. In this talk, I will review the current state of birefringence measurements from CMB polarization data, commenting on the impact of instrumental systematics and Galactic dust on the analysis. As the significance of the measurement continues to increase, I will also discuss the potential physical origin of the signal, focusing on axion-like particles as the most likely candidate.

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