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Cosmic Birefrigence: Cross-Spectra and Cross-Bispectra with CMB Anisotropies

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Parity-violating extensions of Maxwell electromagnetism induce a rotation of the linear polarization plane of photons during propagation. This effect, known as cosmic birefringence, impacts on the Cosmic Microwave Background (CMB) observations producing a mixing of E and B polarization modes which is otherwise null in the standard scenario. Such an effect is naturally parametrized by a rotation angle which can be written as the sum of an isotropic component α_0 and an anisotropic one $\delta\alpha(\hat{\mathbf{n}})$. We have computed angular power spectra and bispectra involving $\delta\alpha$ and the CMB temperature and polarization maps. In particular, contrarily to what happens for the cross-spectra, we have shown that even in absence of primordial cross-correlations between the anisotropic birefringence angle and the CMB maps, there exist non-vanishing three-point correlation functions carrying signatures of parity-breaking physics. Furthermore, we find that such angular bispectra still survive in a regime of purely anisotropic cosmic birefringence. These bispectra represent an additional observable aimed at studying cosmic birefringence and its parity-violating nature beyond power spectrum analyses. Moreover, we have estimated that among all the possible birefringent bispectra, $\langle\delta\alpha\, TB\rangle$ and $\langle\delta\alpha\, EB\rangle$ are the ones which contain the largest signal-to-noise ratio. Once the cosmic birefringence signal is taken to be at the level of current constraints, we show that these bispectra are within reach of future CMB experiments, as LiteBIRD.

In-person participation

Yes

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