Cosmic Polarization Rotation (CPR) induced from Pseudoscalar-Photon interaction and New CPR Constraints from SPTPOL AND BICEP2 Detections of B-Mode Polarization in CMB

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We first review the cosmic polarization rotation (CPR) effects induced by pseudoscalar-photon interaction on CMB [1]. The BICEP2 collaboration has recently detected the cosmic microwave background (CMB) B-mode polarization around l ~ 80, with the tensor-to-scalar ratio r = 0.2. We propose two modifications of their analysis of the BB power spectra: 1) include in the model also the effects induced by the cosmic polarization rotation, in addition to the gravitational lensing and the inflationary gravitational waves components, 2) fit also the data available at l > 500, in addition to the BICEP2 data at smaller l. Our fits using BICEP2 and SPTpol data constrain the mean cosmic polarization rotation angle $\langle\alpha\rangle$ and its fluctuations $\delta\alpha$ with $(\eta^2\langle\alpha\rangle^2 + \langle\delta\alpha^2\rangle)^{1/2} < 0.0345$ rad (1.97°) where (1−η) is the efficiency in uniform angle de-rotation [2]. The inclusion of polarization rotation in the model changes slightly the tensor-to-scalar ratio ($r = 0.18 \pm 0.03$). This method of constraining the cosmic polarization rotation is new, is complementary to previous tests, which use the radio and optical/UV polarization of radio galaxies and the CMB E-mode polarization, and adds a new constraint for the sky areas observed by SPTpol and BICEP2.

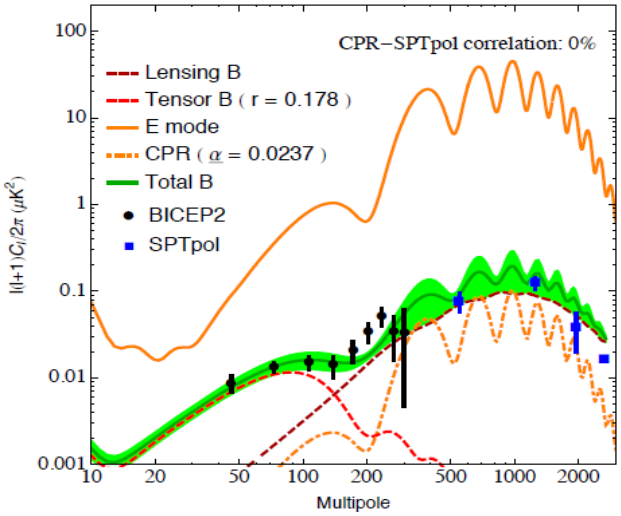

Figure 1. The B-mode spectrum showing the best fit (dark green line) and the one σ region (green band) to the BICEP2 (black filled circles) and SPTpol data (blue filled squares) with the vertical bar showing standard deviation of each data point for a 0% correlation. The E-mode is plotted for reference.

References:

[1] W.-T. Ni, Reports on Progress in Physics, 73, 056901 (2010).

[2] Sperello di Serego Alighieri, Wei-Tou Ni and Wei-Ping Pan, arXiv:1404.1701 (2014).