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Determination of the Systematics Related to Polarization Angle Uncertainty and Its Impact on r

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The new generation of CMB B-mode experiments will reach limits of sensitivity never achieved before in order to detect the elusive primordial B-mode signal. However, all these efforts will be futile if we lack a tight control of the systematics. Here, we focus on the systematic that arises from the uncertainty of the polarization angles calibration. Miscalibrated polarization angles induce a mixing of E and B modes which obscures the primordial B-mode signal. We introduce an iterative power-spectra maximum likelihood based method to calculate the polarization angles ($\bar{\alpha}$) from the multi-frequency signal. The basis behind this methodology grounds on nulling the C_ℓ^{EB} power-spectra. Two major assumptions are made: i) the rotation angles are small (
$lesssim 6$ deg), and, ii) the covariance matrix does not depend on $\bar{\alpha}$ (before the start of the iteration). With these assumptions we obtain an analytical linear system which leads to a very fast computational implementation. We show that with this methodology we are able to determine the rotation angle for each frequency with enough accuracy. In particular, this is proved by applying a parametric component separation technique to recover the CMB in three scenarios: i) signal without rotation angles, ii) signal with rotation angles, and iii) de-rotated signal with the estimation of $\bar{\alpha}$. We find that the systematic introduced by leftover polarization angles in the tensor-to-scalar ratio r are removed after the signal is corrected.

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