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Fast algorithm for the computation of the CMB polarization TE power spectrum using non-circular beam

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A precise measurement of the Cosmic Microwave Background (CMB) anisotropy has been one of the foremost concerns in modern cosmology as it provides a valuable information on the cosmology of the Universe. The estimation of the CMB power spectrum is complicated by different systematics. For the polarization experiments, the signals are rather fainter in comparison with the CMB total intensity, which may lead to an important bias in the estimation of the angular power spectrum. One of the most important source of bias in CMB polarization experiment is the beam asymmetry. We present a semi-analytical framework using the pseudo-C_l estimator to compute the power spectrum TE of the temperature anisotropy and the E-component of the polarization radiation field using non-circular beams. We assume that the beam is non-rotating. We adopt a model of beams obtained from a perturbative expansion of the beam around a circular (axisymmetric) beam in harmonic space. We compute the resulting bias matrix which relates the true power spectrum with the observed one by using an efficient algorithm for rapid computation. We show that for a multipole up to l_{max}=500, the bias matrix can be computed in less than one second with a single CPU processor at 2.53 GHz. We find that the systematic effect induced by the beam asymmetry in the temperature and polarization power spectrum at the peak of the bias matrix for the WMAP and Planck experiments can be as large as a few 10 to 20%.

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