Reconstruction of lensing from the cosmic microwave background polarization
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Abstract
Gravitational lensing of the cosmic microwave background (CMB) polarization field has been recognized as a potentially valuable probe of the cosmological density field. We apply likelihood-based techniques to the problem of lensing of CMB polarization and show that if the $B$-mode polarization is mapped, then likelihood-based techniques allow significantly better lensing reconstruction than is possible using the previous quadratic estimator approach. With this method the ultimate limit to lensing reconstruction is not set by the lensed CMB power spectrum. Second-order corrections are known to produce a curl component of the lensing deflection field that cannot be described by a potential; we show that this does not significantly affect the reconstruction at noise levels greater than $0.25 \mu \text{K arcmin}$. The reduction of the mean squared error in the lensing reconstruction relative to the quadratic method can be as much as a factor of two at noise levels of $1.4 \mu \text{K arcmin}$ to a factor of ten at $0.25 \mu \text{K arcmin}$, depending on the angular scale of interest.