

Our simulated data vector for the joint LSST & CMB S4 analysis consists of all the auto and cross-spectra of galaxy projected density, galaxy convergence and CMB convergence for all the lens and source bins:

$$\mathbf{D}_{\text{LSST \& CMB S4}} = \left(\underbrace{C_\ell^{g_i g_j}}_{\text{clustering}}, \underbrace{C_\ell^{g_i \kappa_{\text{CMB}}}}_{\text{galaxy-CMB lensing}}, \underbrace{C_\ell^{g_i \kappa_{\text{gal},j}}}_{\text{galaxy-galaxy lensing}}, \underbrace{C_\ell^{\kappa_{\text{CMB}} \kappa_{\text{CMB}}}}_{\text{CMB lensing auto}}, \underbrace{C_\ell^{\kappa_{\text{CMB}} \kappa_{\text{gal},j}}}_{\text{CMB lensing-galaxy lensing}}, \underbrace{C_\ell^{\kappa_{\text{gal},i} \kappa_{\text{gal},j}}}_{\text{shear tomography}} \right), 2450 \text{ elements.} \quad (8)$$

Again, let us stress that our LSST & CMB S4 analysis does not include temperature and polarization power spectra from CMB S4, only the convergence κ_{CMB} . For comparison purposes, we also consider an LSST-only analysis:

$$\mathbf{D}_{\text{LSST}} = \left(\underbrace{C_\ell^{g_i g_j}}_{\text{clustering}}, \underbrace{C_\ell^{g_i \kappa_{\text{gal},j}}}_{\text{galaxy-galaxy lensing}}, \underbrace{C_\ell^{\kappa_{\text{gal},i} \kappa_{\text{gal},j}}}_{\text{shear tomography}} \right), 2075 \text{ elements.} \quad (9)$$

Finally, for the purpose of calibrating the shear bias, it is useful to compare the following two combinations:

$$\mathbf{D}_{\text{Combi 1}} = \left(\underbrace{C_\ell^{\kappa_{\text{CMB}} \kappa_{\text{CMB}}}}_{\text{CMB lensing auto}}, \underbrace{C_\ell^{\kappa_{\text{CMB}} \kappa_{\text{gal},j}}}_{\text{CMB lensing-galaxy lensing}}, \underbrace{C_\ell^{\kappa_{\text{gal},i} \kappa_{\text{gal},j}}}_{\text{shear tomography}} \right), 1650 \text{ elements;} \quad (10)$$

$$\mathbf{D}_{\text{Combi 2}} = \left(\underbrace{C_\ell^{g_i g_j}}_{\text{clustering}}, \underbrace{C_\ell^{g_i \kappa_{\text{CMB}}}}_{\text{galaxy-CMB lensing}}, \underbrace{C_\ell^{g_i \kappa_{\text{gal},j}}}_{\text{galaxy-galaxy lensing}} \right), 800 \text{ elements,}$$