DESC Shear Calibration

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See Amon et al. [2105.13543], MacCrann et al. [2012.08567]

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- Shear correlation function: $\xi^{ij}_{\rm obs} = (1+m^i)(1+m^j)\xi^{ij}$

Shear Calibration

Shear calibration parameters are sampled when running chains via, e.g., CosmoSIS:

```
[shear_calibration_parameters]
m1 = gaussian 0.0 0.0091
m2 = gaussian 0.0 0.0078
m3 = gaussian 0.0 0.0076
m4 = gaussian 0.0 0.0076
```

shear is calibrated by marginalizing over these parameters

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- Construct unbiased estimator of the shear *bias* following Pujol et al. [1806.10537]

$$\hat{m} = \frac{\langle \hat{g}^+ \rangle - \langle \hat{g}^- \rangle}{2|g|} - 1 \qquad \text{multiplicative bias}$$

$$\hat{c} = \frac{\langle \hat{g}^+ \rangle + \langle \hat{g}^- \rangle}{2} \qquad \text{additive bias}$$

where $\langle \hat{g}^+ \rangle$ and $\langle \hat{g}^- \rangle$ are mean measured shears from *image simulations with equal and opposite true shears of magnitude* $|g|$

DES Y6 Image Simulations

- Simulate 12 shear variants to measure response of observed shear due to true shear at different redshifts
- Simulate 1000 tiles (~ 450 deg^2 total) of DES Y6 data
- Simulate single-epoch images with features from corresponding DES images
  - Pixel geometry (4096×2048 pixel DECam CCD exposures)
  - Variance plane of Gaussian noise
  - World-coordinate system (WCS) solution
  - PIFF point-spread function (PSF) models
  - Bad pixel masks including bright stars, bleed trails, etc.
- Galaxy properties from bulge+disk fits to COSMOS field galaxies with positions and luminosity sampling from Cardinal simulations
- *Gaia* stars with matched `lsst_sim` (TRILEGAL) extension to faint magnitudes

DES Y6 Image Simulations – Data

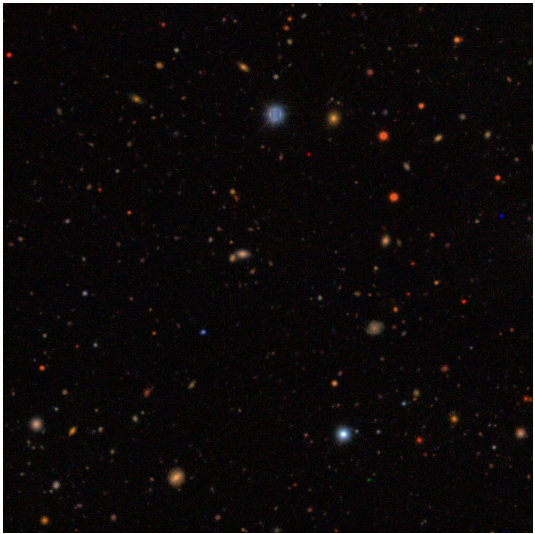
Input data (1000 tiles, ~ 450 deg^2)

- Exposure data & systematics (4 bands) [16T]
- Galaxies: bulge+disk fits to COSMOS resampled with Cardinal [95G]
- Stars: *Gaia* + `lsst_sim` [1.6G]

Output data (400 tiles, 12 shears)

- simulation outputs (coadds, etc.) [67T]
- reduced MDET catalogs [111G]

DES Y6 Shear Calibration – Image Simulations



DES Y6 Shear Calibration – Image Simulation Campaigns

Image Simulations			Shear Algorithms	
configuration	# tiles	# shears	MDET	BFD
fiducial	1000	12	✓	✓
no stars	400	2	✓	✓
median color	400	2	✓	
grid (median color)	400	2	✓	
grid (true color)	400	2	✓	✓
grid (exp)	100	2	✓	

m_i and $\delta\bar{z}_i$ measured from the fiducial simulations for the final shear calibration

DESC Shear Calibration

DESC Shear Calibration – Discussion Points

- Shear measurement algorithms
  - MDET
  - AnaCal
  - BFD
  - Bayesian pipelines
- Consistent calibration across shear measurement methods
- Image simulations
  - DES Y6-like data-driven monte carlo simulations of Rubin observations (seacliff)
  - ab-initio sims to test effects of residuals from ISR tasks on calibrated visit images for shear recovery (with imSim)
  - Direct simulations of cell-based coadds for shear calibration and SSI (Zhou)
- Synthetic source injection