# Euclid

| SURVEYS | | |
|---|---|---|
| | Area (deg2) | Description |
| Wide Survey | 15,000 (required)<br>20,000 (goal) | Step and stare with 4 dither pointings per step. |
| Deep Survey | 40 | In at least 2 patches of > 10 $deg^2$<br>2 magnitudes deeper than wide survey |

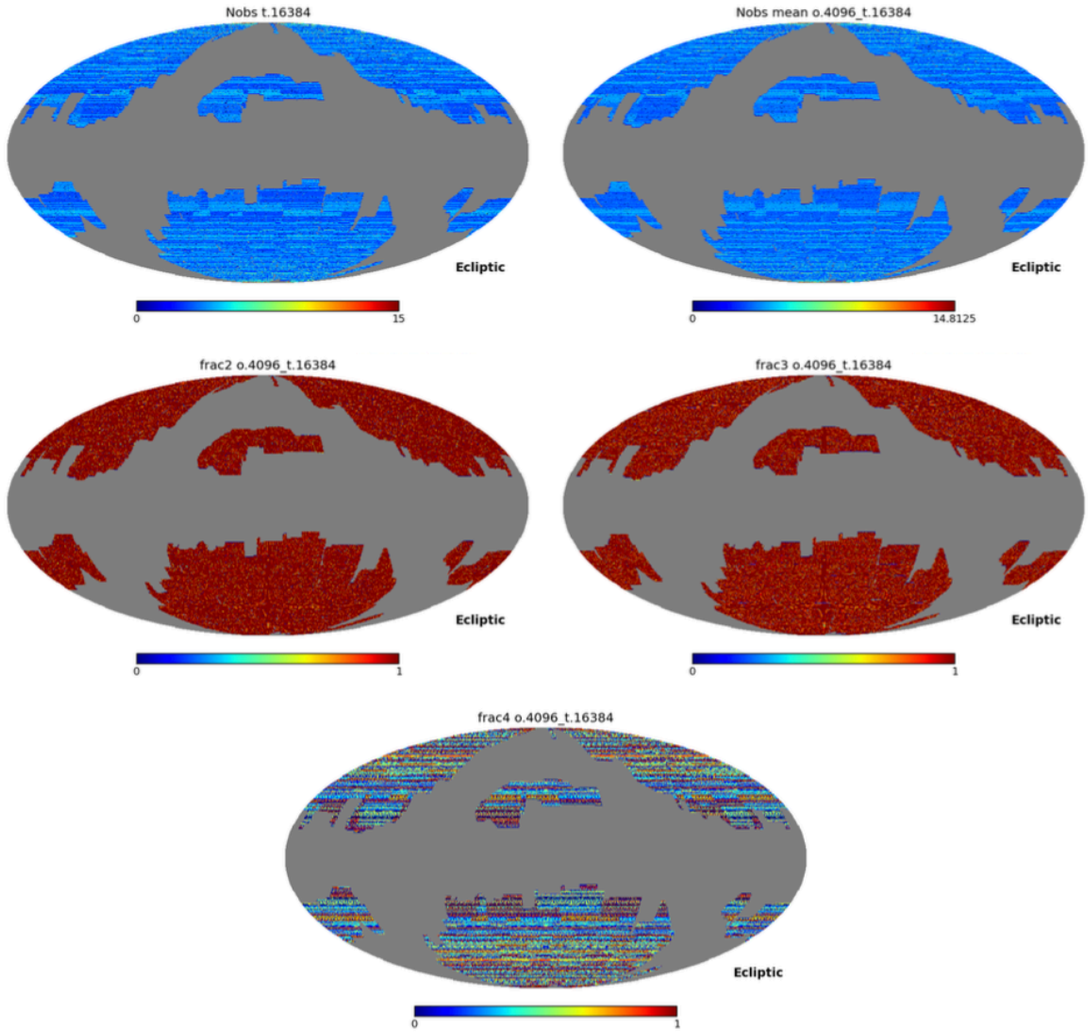
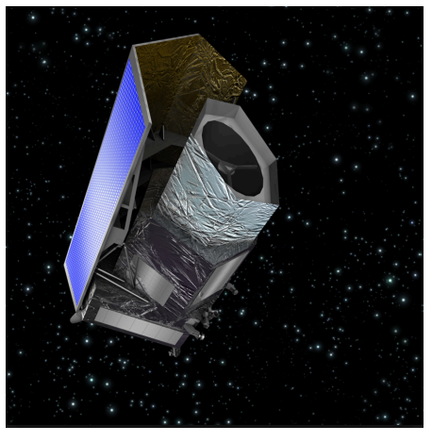



Figure 2: Full sky maps of the Wide survey. From left to right, top to bottom: number of observations at high resolution (Nside=16384), number of observations at medium resolution (Nside=4096). Fraction of the subpixels that are seen at least twice. Fraction of the subpixels that are seen at least two times. Fraction of the subpixels that are seen at least three times.



Paniez Paykari

Feb 6 2019

# Euclid

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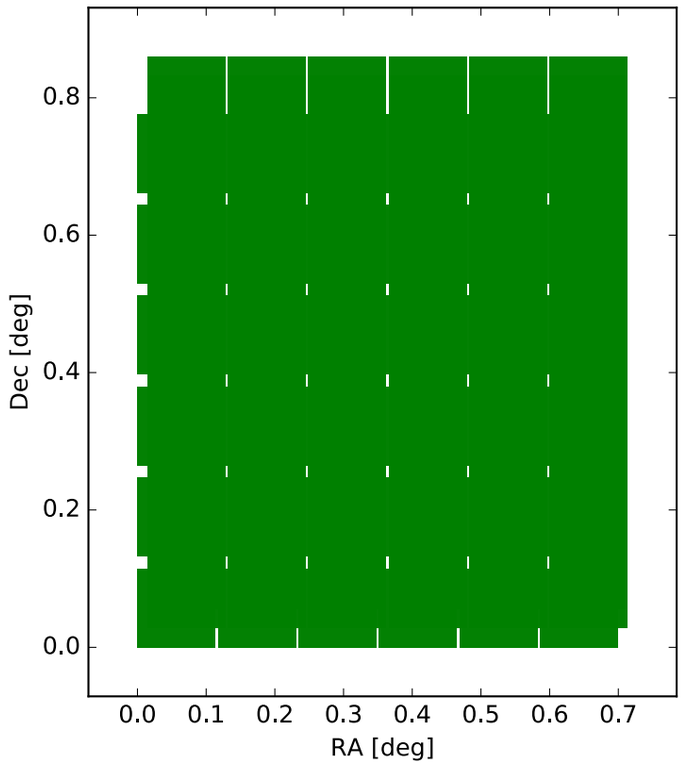
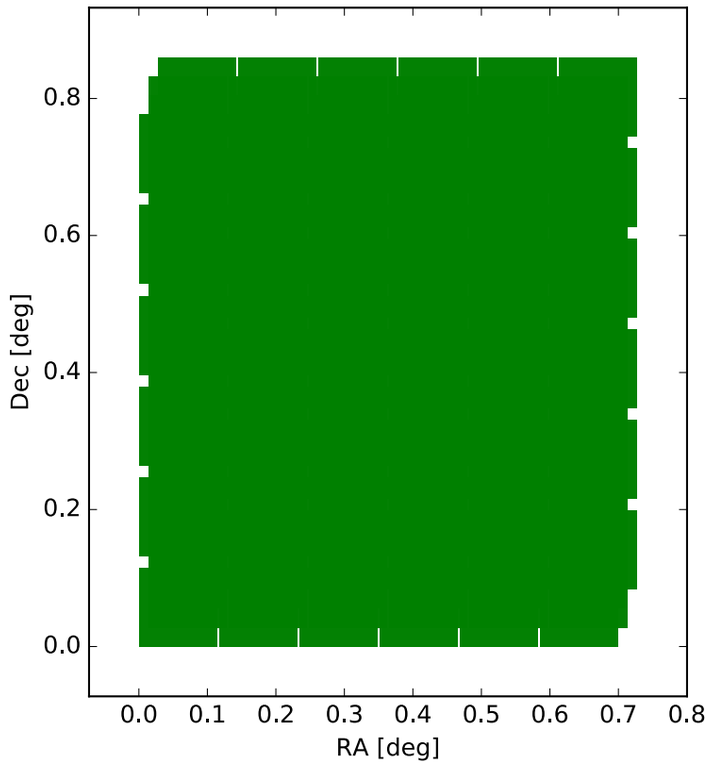
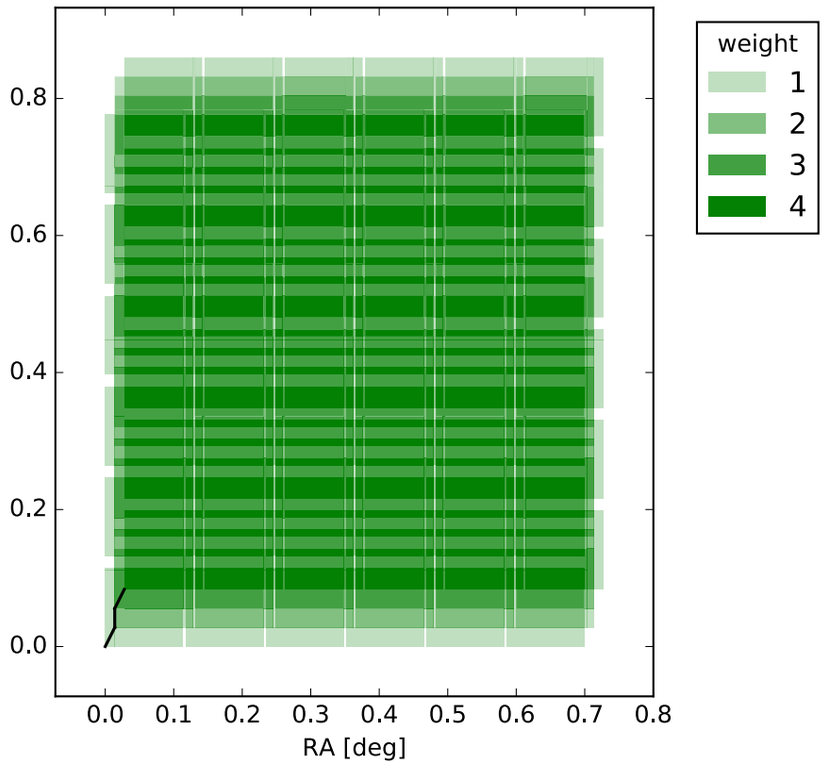


| PAYLOAD | | | | | |
|---|---|---|---|---|---|
| Telescope | 1.2 m Korsch, 3 mirror anastigmat, f=24.5 m | | | | |
| Instrument | VIS | NISP | | | |
| Field-of-View | 0.787×0.709 $deg^2$ | 0.763×0.722 $deg^2$ | | | |
| Capability | Visual Imaging | NIR Imaging Photometry | | | NIR Spectroscopy |
| Wavelength range | 550– 900 nm | Y (920-1146nm), | J (1146-1372 nm) | H (1372-2000nm) | 1100-2000 nm |
| Sensitivity | 24.5 mag<br>10σ extended source | 24 mag<br>5σ point source | 24 mag<br>5σ point source | 24 mag<br>5σ point source | 3 $10^{-16}$ erg cm-2 s-1<br>3.5σ unresolved line flux |
| Detector Technology | 36 arrays<br>4k×4k CCD | 16 arrays<br>2k×2k NIR sensitive HgCdTe detectors | | | |
| Pixel Size<br>Spectral resolution | 0.1 arcsec | 0.3 arcsec | | | 0.3 arcsec<br>R=250 |

The NISP Instrument is the near-infrared Spectrometer and Photometer operating in the 0.9-2.0 micron range at a temperature lower than 140K, except for detectors, cooled to ~120 K. The warm electronics will be located in the service module, at a temperature higher than 240 K.

The NISP instrument has two main observing modes: the photometric mode, for the acquisition of images with broad band filters, and the spectroscopic mode, for the acquisition of slitless dispersed images on the detectors. The main elements of the NISP instrument are listed in Table 4.4.

The main survey is the Wide Survey (WS), which covers ~15,000 $deg^2$ of extragalactic sky (|b|>30 deg) at a depth to observe ~30 galaxies per $arcmin^2$ useful for weak lensing, corresponding to a detection limit of 10 sigma extended source at $m_{AB}$=24.5, to reach 3.5 sigma for emission lines at $3\times10^{-16}$ erg $cm^{-1}s^{-1}$, and have NIR imaging in Y, J and H at $m_{AB}$= 24 (5 sigma point source). This is achieved by the exposure times considered in the previous section.

- Official ESA launch date is **December 2021**
    - more realistically around mid 2022

- Nominal survey lasts 6 years to cover 15,000 deg^2

- GRISM:
    - RED grism is used for cosmology
    - BLUE for deep field

- Type of Data:
    - Shapes for about 2 billion galaxies,
    - NIR imaging in Y,J,K down to m_AB=24 (5 sigma) which is enormously valuable (it would take 600 years with VISTA)
    - NIR spectroscopy for about 35 million galaxies.

- Euclid will make everything public (including software) through public archive
    - 3 main data releases
        - year 1 + 14 months; year 3 +14 months; 6 years + 14months (roughly)

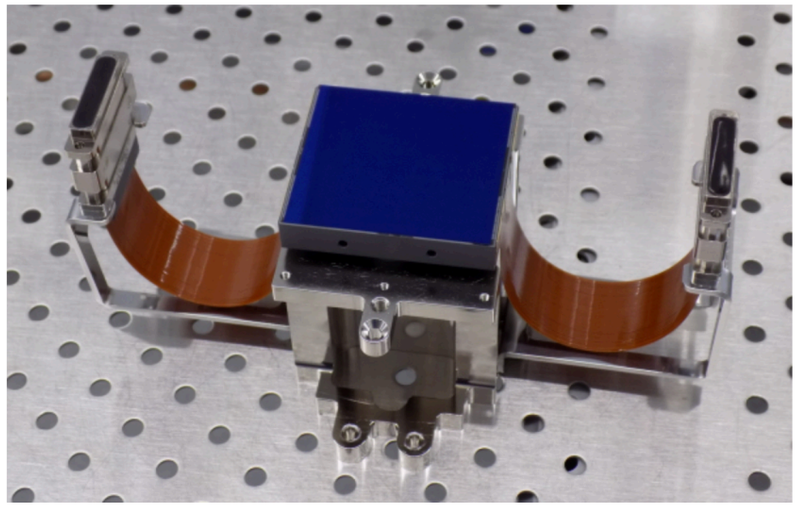
- Joining Euclid?
    - Motivate joining at this stage and describe what they would want to contribute too (ideally not more modified gravity theories!)

- Euclid vs Others:
    - DESI covers a similar volume — ideally we would combine the constraints, where Euclid covers the high redshift range, and DESI the lower redshifts (this is one of the reasons to skip the blue grism as it overlaps too much with the DESI redshift range).
    - PFS is smaller area, but deeper, so very different parameter range.
    - Both 4MOST and WEAVE also target lower z, but great for galaxy-galaxy lensing and clustering.
    - Gaia is really shallow. For us mostly useful for calibration. But with Euclid positions we can extend baseline for proper motions.

# MSSL

- Leading manufacturing of VIS instrument

  Mark Cropper



- Leading *Science Performance Verifications Project*

Paniez Paykari

## Verifying the Performance of Cosmic Shear Experiments


P. Paykari[1]⋆, T. Kitching[1], H. Hoekstra[2], R. Azzollini[1], V. F. Cardone[3], M. Cropper[1], C. Duncan[4], A. Kannawadi[2], L. Miller[4], C. Wallis[1], H. Aussel[5], I. F. Conti, E. v. Uitert[6,7]

[1] *Mullard Space Science Laboratory, University College London, Holmbury St Mary, Dorking, Surrey RH5 6NT*
[2] *Leiden Observatory, Leiden University, PO Box 9513, NL-2300 RA Leiden, the Netherlands*
[3] *Department of Physics, University of Oxford, The Denys Wilkinson Building, Keble Road, Oxford OX1 3RH*
[4] *National Institute of Astrophysics INAF, Astronomical Observatory of Rome*
[5] *AIM, CEA, CNRS, Université Paris-Saclay, Université Paris Diderot, Sorbonne Paris Cité, UMR 7158, F-91191 Gif-sur-Yvette, France*
[6] *Department of Physics and Astronomy, University College London, Gower Street, London WC1E 6BT*
[7] *Argelander-Institut für Astronomie, Auf dem Hügel 71, 53121 Bonn, Germany*



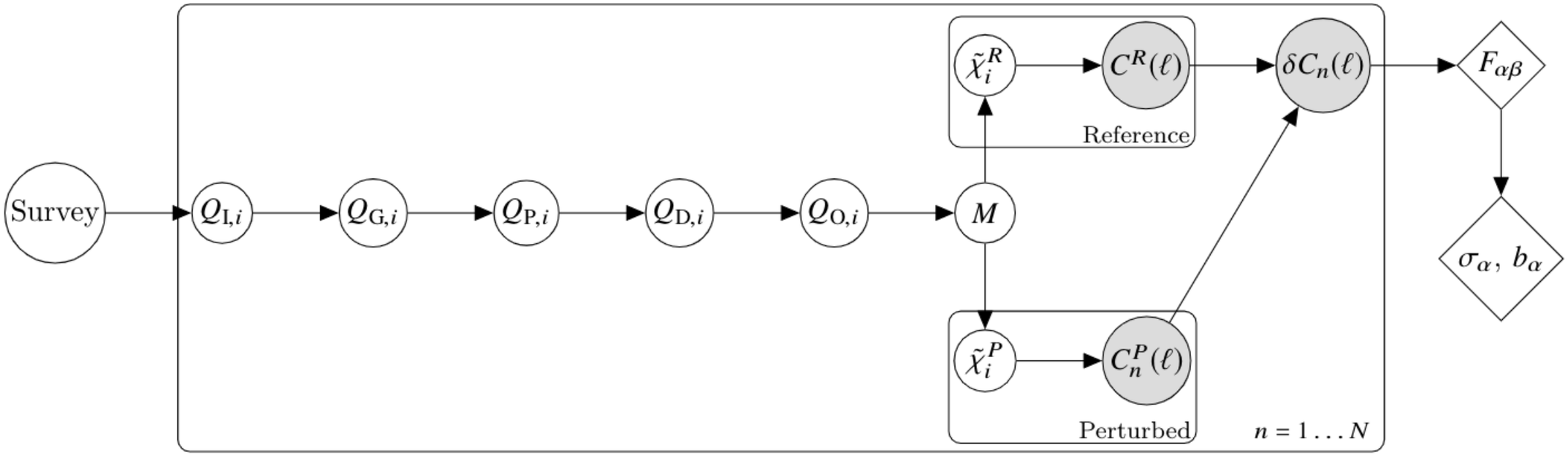
Accepted XXX. Received YYY; in original form ZZZ



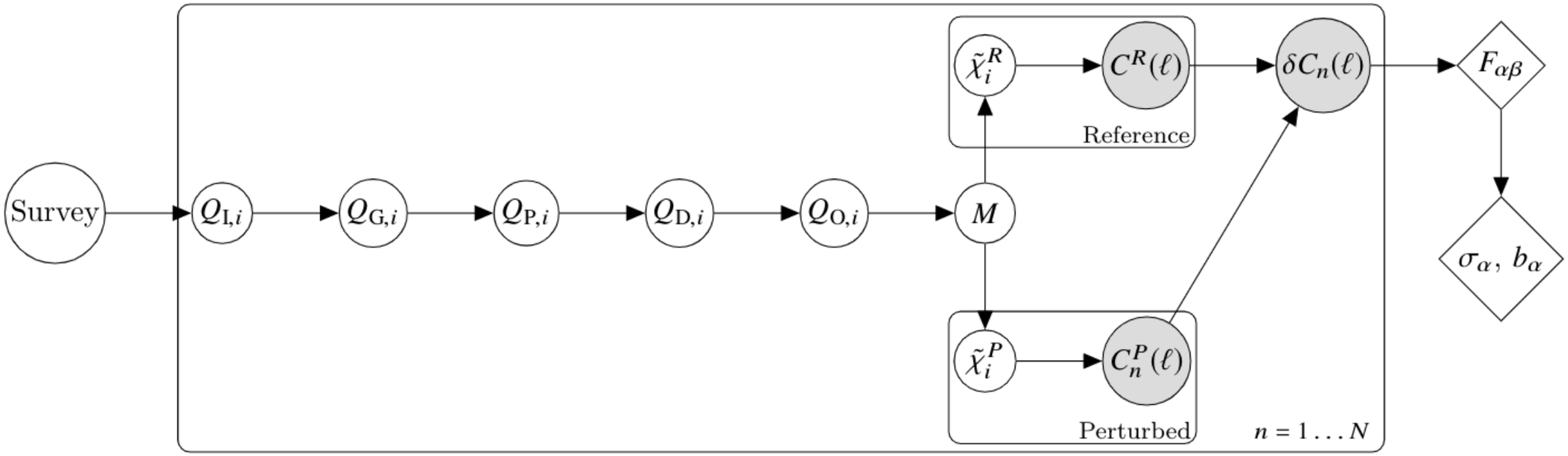
**ABSTRACT**

We present an 'end-to-end' approach that introduces sources of bias in a modelled weak lensing survey on a galaxy-by-galaxy level, thus capturing spatial and temporal variations, as well as dependencies on galaxy properties. The residual biases are propagated through to cosmic shear power spectra and cosmological parameter estimates to quantify how our imperfect knowledge of the pipeline changes the maximum likelihood values of the dark energy parameters. Our methodology can be applied to any weak lensing survey where the instrumental design and survey characteristics are known. As a demonstration of the usefulness of our approach we quantify the impact of an imperfect correction for charge transfer inefficiency (CTI) and errors in the modelling of the point spread function (PSF) for *Euclid*. Despite the stringent requirements for this survey, we find that the biases introduced by both CTI and PSF can be corrected to acceptable levels.

# SPV


Survey
$Q_{\mathrm{I},i}$
$Q_{\mathrm{G},i}$
$Q_{\mathrm{P},i}$
$Q_{\mathrm{D},i}$
$Q_{\mathrm{O},i}$
$M$
$\tilde{\chi}_i^R$
$C^R(\ell)$
Reference
$\tilde{\chi}_i^P$
$C_n^P(\ell)$
Perturbed
$n = 1 \ldots N$
$\delta C_n(\ell)$
$F_{\alpha\beta}$
$\sigma_\alpha,\ b_\alpha$

# SPV


Survey
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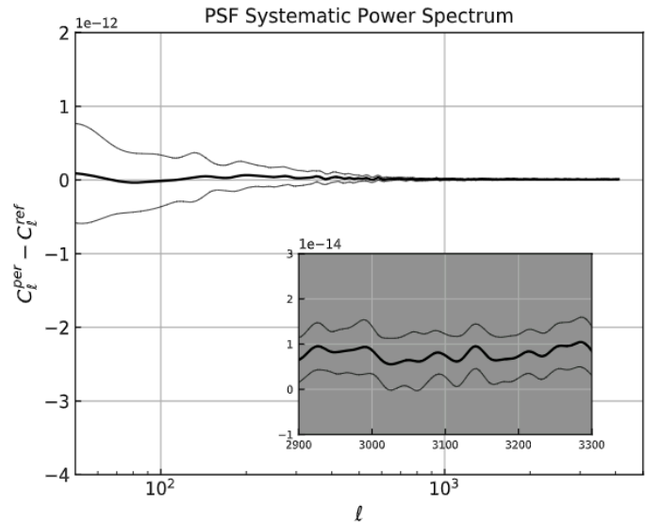
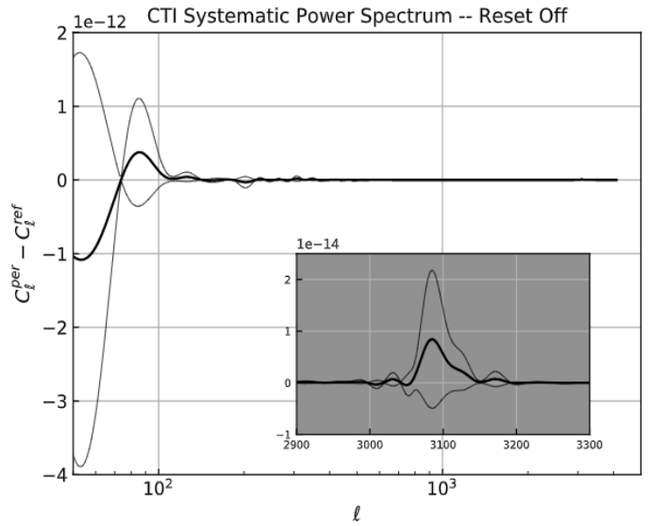
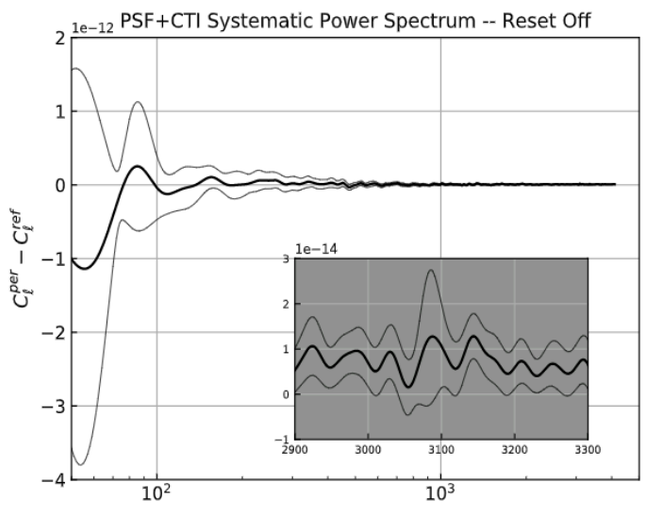
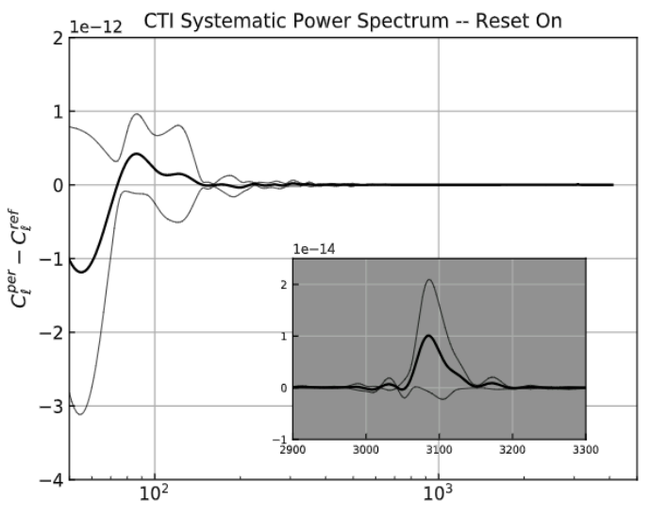
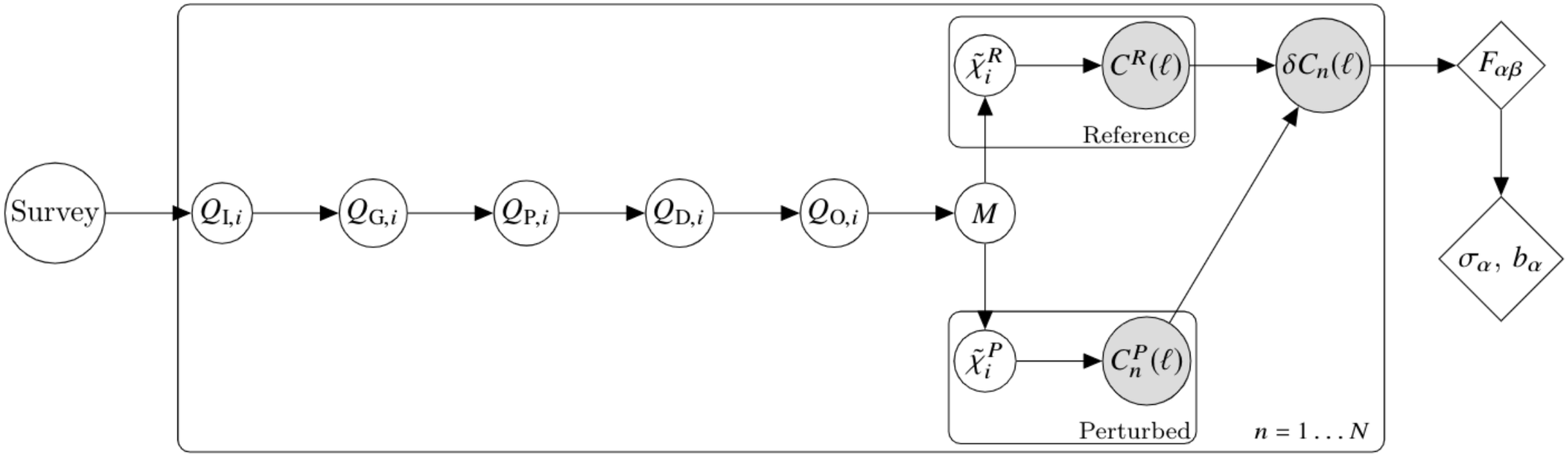

PSF Systematic Power Spectrum
1e−12
1e−14
$C_\ell^{per} - C_\ell^{ref}$
$\ell$


CTI Systematic Power Spectrum -- Reset Off
1e−12
1e−14
$C_\ell^{per} - C_\ell^{ref}$
$\ell$


PSF+CTI Systematic Power Spectrum -- Reset Off
1e−12
1e−14
$C_\ell^{per} - C_\ell^{ref}$
$\ell$


CTI Systematic Power Spectrum -- Reset On
1e−12
1e−14
$C_\ell^{per} - C_\ell^{ref}$
$\ell$

# SPV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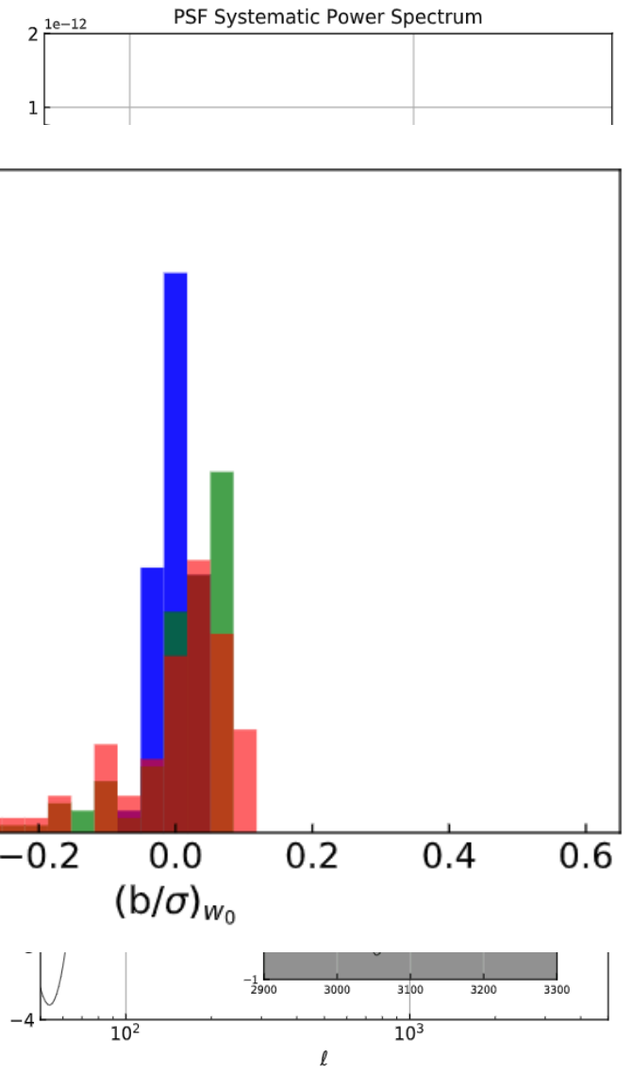
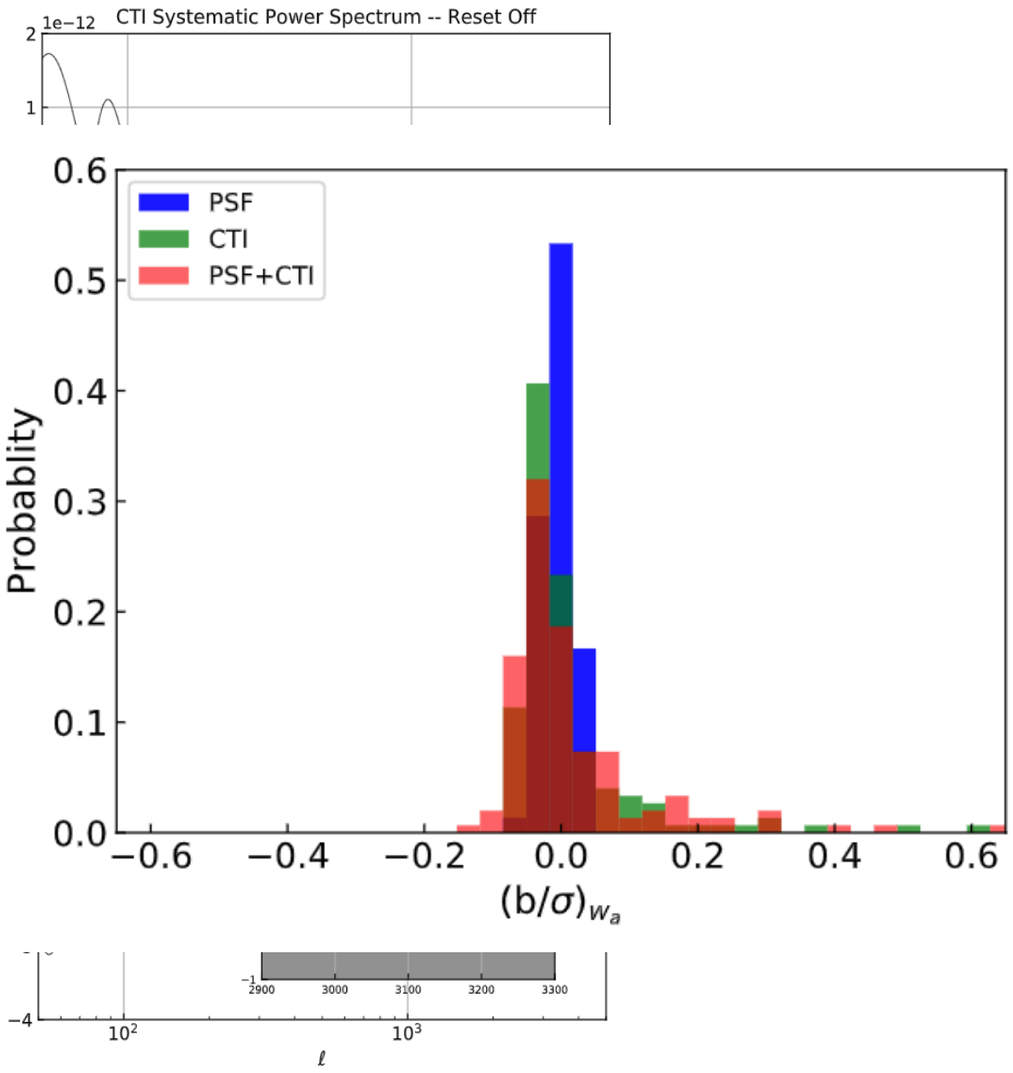

PSF Systematic Power Spectrum
1e−12
PSF
CTI
PSF+CTI
Probablity
$(b/\sigma)_{w_0}$
$\ell$


CTI Systematic Power Spectrum -- Reset Off
1e−12
PSF
CTI
PSF+CTI
Probablity
$(b/\sigma)_{w_a}$
$\ell$