HSC

HSC Year 3 Weak Lensing Cosmology Results

The Hyper Suprime-Cam Subaru Strategic Program Collaboration

KAVLI IPMU INSTITUTE FOR THE PHYSICS AND MATHEMATICS OF THE UNIVERSE

Carnegie Mellon University

VET TES EN NOV TAM TVM

NAOJ

IUCAA

Subaru Hyper Suprime-Cam Survey

The Hyper Suprime-Cam Subaru Strategic Program is led by astronomical communities in Japan, Taiwan and Princeton University.

Funding agencies:

- Ministry of Education, Culture, Sports, Science and Technology (MEXT)
- The Japan Society for Promotion of Science (JSPS)
- Japan Science and Technology Agency (JST)
- The Toray Science Foundation
- National Astronomical Observatories Japan (NAOJ)
- Kavli Institute for the Physics and Mathematics of the Universe (Kavli IPMU)
- High Energy Accelerator Research Organization (KEK)
- Academia Sinica Institute for Astronomy and Astrophysics in Taiwan (ASIAA)
- Princeton University

Instrumentation and Software development:

- NAOJ, Kavli IPMU, University of Tokyo, KEK, ASIAA, Princeton

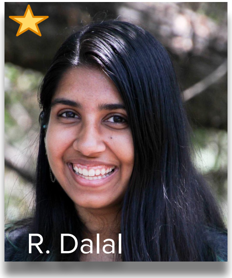
We are honored and grateful for the opportunity to observe the Universe from Maunakea, which has cultural, historical and natural significance in Hawaii.

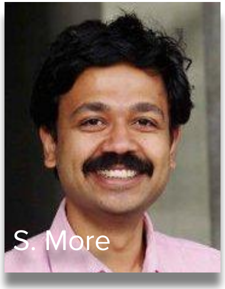
Weak lensing working group


★ S. Sugiyama


★ T. Zhang


★ X. Li


★ R. Dalal


S. More


R. Mandelbaum

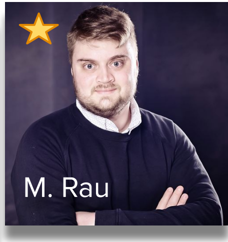

H. Miyatake


M. Takada


M. Strauss


★ Y. Kobayashi


★ A. Kannawadi


★ M. Rau


W. Luo


A. J. Nishizawa


A.Nicola

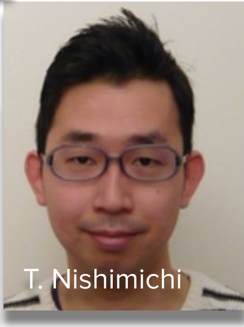

R. Takahashi


K. Osato


M. Shirasaki


M. Oguri


T. Hamana


T. Nishimichi

And efforts of many more!

Key weak lensing group publications: HSC Year 3

- The three-year shear catalog of the Subaru Hyper Suprime-Cam SSP Survey (**Li X.**, et al. 2022, PASJ, 74, 2)
- A General Framework for Removing Point Spread Function Additive Systematics in Cosmological Weak Lensing Analysis (**Zhang T.** et al. 2022, MNRAS submitted, arXiv:2212.03257)
- Weak Lensing Tomographic Redshift Distribution Inference for the Hyper Suprime-Cam Subaru Strategic Program three-year shape catalogue (**Rau, M.** et al. 2022, MNRAS, submitted, arXiv:2211.16516)
- Hyper Suprime-Cam Year 3 Results: Cosmology from Cosmic Shear Two-Point Correlation Functions (**Li X.,** et al. 2023, PRD, to be submitted)
- Hyper Suprime-Cam Year 3 Results: Cosmology from Cosmic Shear Power Spectra (**Dalal R.,** et al. 2023, PRD, to be submitted)
- Hyper Suprime-Cam Year 3 Results: Measurements of the Clustering of SDSS-BOSS galaxies, galaxy-galaxy lensing and cosmic shear (More S., et al. 2023, PRD, to be submitted)
- Hyper Suprime-Cam Year 3 Results: Cosmology from Galaxy Clustering and Weak Lensing with HSC and SDSS using the Minimal Bias Model (**Sugiyama S.,** et al. 2023, PRD, to be submitted)
- Hyper Suprime-Cam Year 3 Results: Cosmology from Galaxy Clustering and Weak Lensing with HSC and SDSS using the Emulator Based Halo Model (Miyatake H., et al. 2023, PRD, to be submitted)

https://hsc-release.mtk.nao.ac.jp/doc/index.php/wly3/

Early career scientists leading the projects marked in bold

Webinar structure

- Overview (Hironao Miyatake)
- HSC Year 3 shape catalog (Xiangchong Li)
- Source redshift distribution inference (Tianqing Zhang)
- Cosmology from cosmic shear power spectra (Roohi Dalal)
- Cosmology from cosmic shear 2 pt correlations (Xiangchong Li)
- Cosmology from 3x2 pt analysis (Sunao Sugiyama)
- Summary and future outlook (Surhud More)
- Question/Answer and Discussion (Rachel Mandelbaum)

Overview

Hironao Miyatake (Kobayashi-Maskawa Institute, Nagoya University)

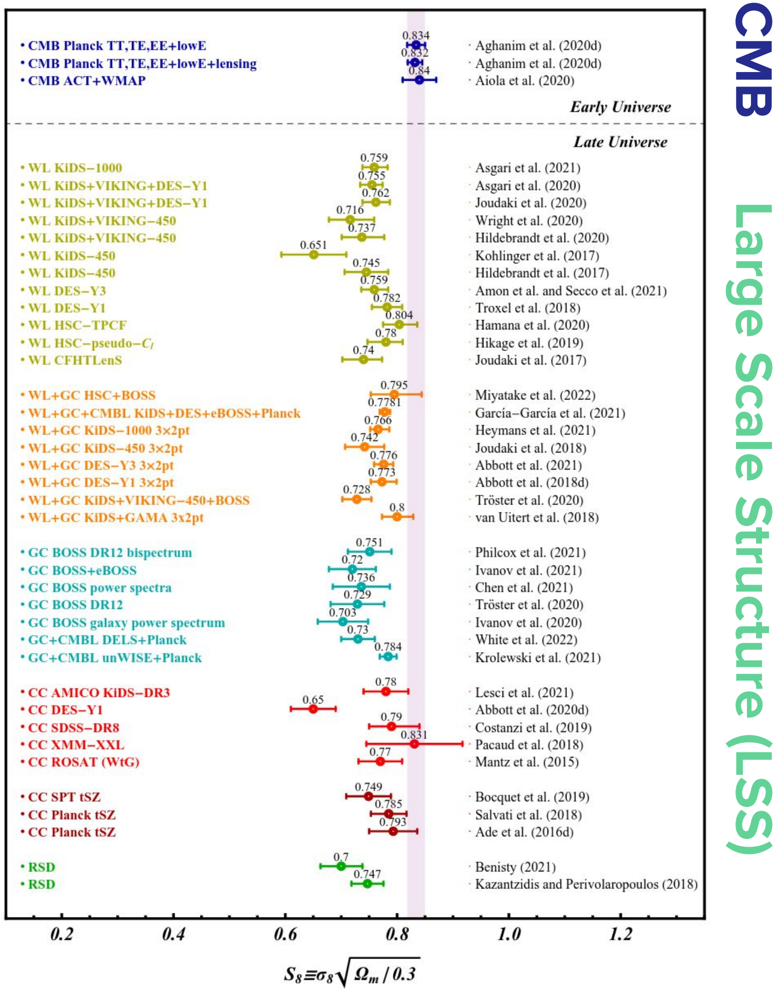
Testing ΛCDM using S_8

$$S_8 \equiv \sigma_8\sqrt{\Omega_m/0.3}$$

- σ_8: Clumpiness of cosmic structure today.
- Ω_m: Energy density of matter (incl. dark matter).

S_8 tension?

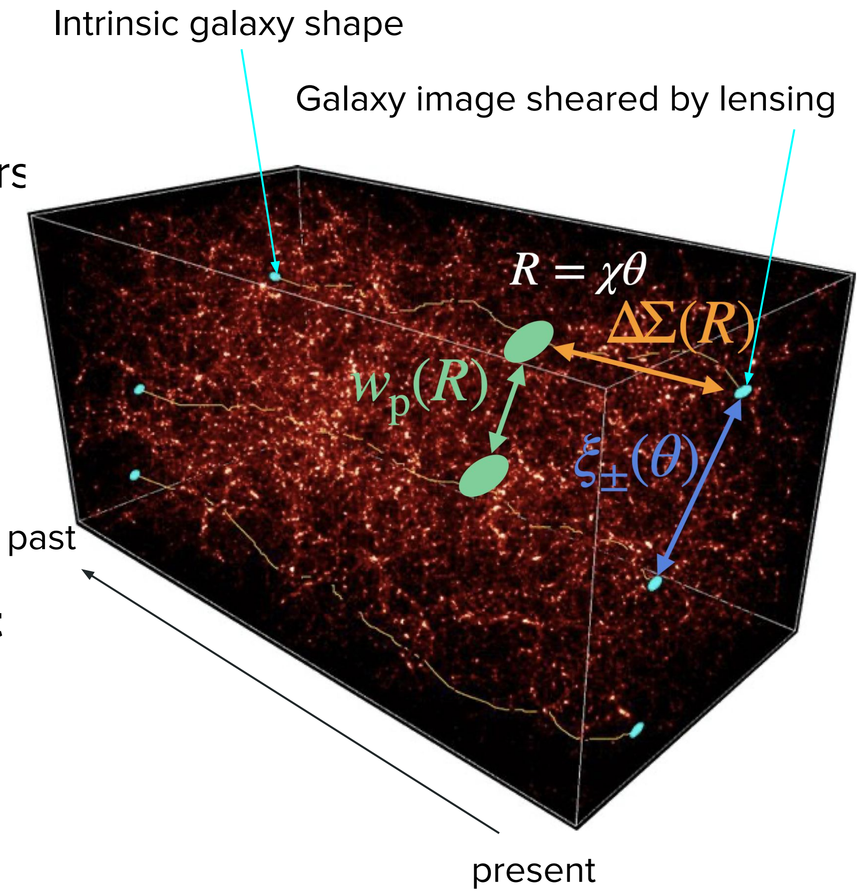
Most **large scale structure probes** (weak lensing, galaxy clustering, galaxy clusters, etc…) prefer smaller S_8 compared to **CMB**, if we assume ΛCDM is correct.



SNOWMASS 2021 Summer study: Abdalla et al. (2022)

Weak Lensing Cosmology

- LSS is sensitive to cosmological parameters $(\Omega_{\rm m}, \sigma_8)$ and $S_8 \equiv \sigma_8\sqrt{\Omega_{\rm m}/0.3}$
- Weak Lensing, a subtle and coherent distortion of distant galaxies, probes the matter distribution (incl. dark matter)
- **Cosmic shear**
    - Auto-correlation of weak lensing shear
- **Galaxy-galaxy clustering x lensing: 2x2pt**
    - Auto-correlation of galaxy positions
    - Cross-correlation of galaxy positions and weak lensing shear
- **Cosmic shear + 2x2pt: 3x2pt**



S. Colombi (IAP), CFHT Team

Subaru Hyper Suprime-Cam (HSC)

- Wide FOV: 1.5 deg. Diameter
- Huge light-collecting power: 8.2m primary mirror
- Superb image quality: seeing~0.6”

HSC is one of the best “weak lensing machines” in the world.

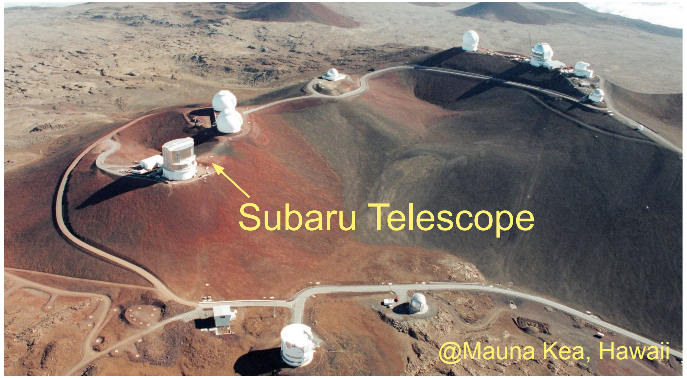
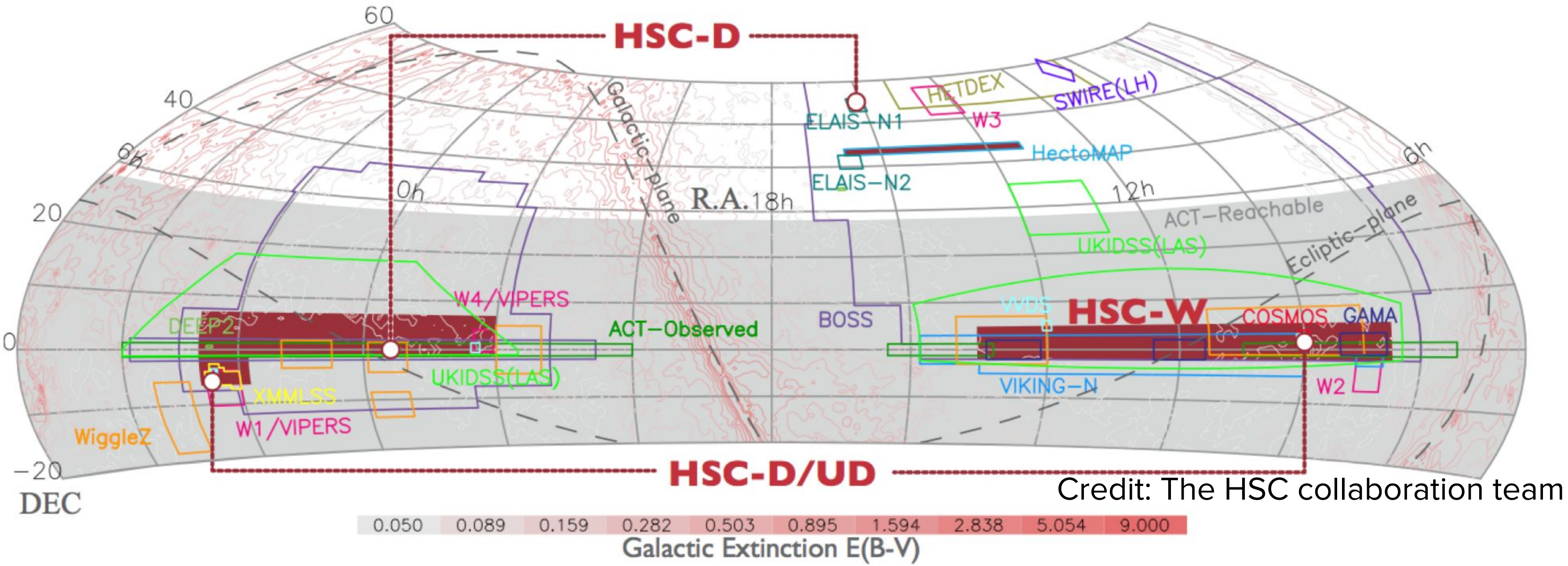


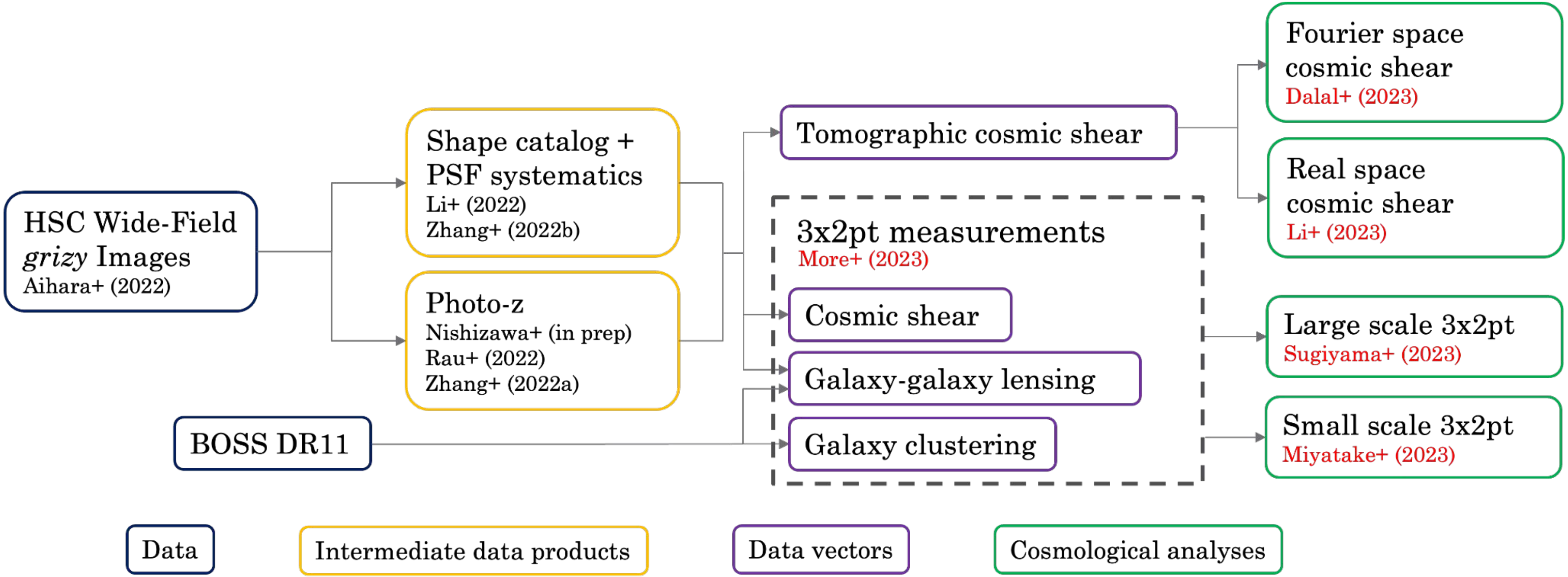
Photo credit: NAOJ / HSC Project

HSC Subaru Strategic Program (SSP) Survey



Credit: The HSC collaboration team

- Wide Layer (~1,100 deg^2, grizy, i_{lim}~26) is designed for weak lensing cosmology.
- Overlaps with other major surveys (SDSS/BOSS, ACT, VIKING, GAMA, VVDS, etc...).
- The survey started in 2014 and was completed in 2021.
- **In this webinar, we will give results from the data taken until April 2019 (416 deg^2).**



HSC Wide-Field *grizy* Images
Aihara+ (2022)

BOSS DR11

Shape catalog + PSF systematics
Li+ (2022)
Zhang+ (2022b)

Photo-z
Nishizawa+ (in prep)
Rau+ (2022)
Zhang+ (2022a)

Tomographic cosmic shear

3x2pt measurements
More+ (2023)

Cosmic shear

Galaxy-galaxy lensing

Galaxy clustering

Fourier space cosmic shear
Dalal+ (2023)

Real space cosmic shear
Li+ (2023)

Large scale 3x2pt
Sugiyama+ (2023)

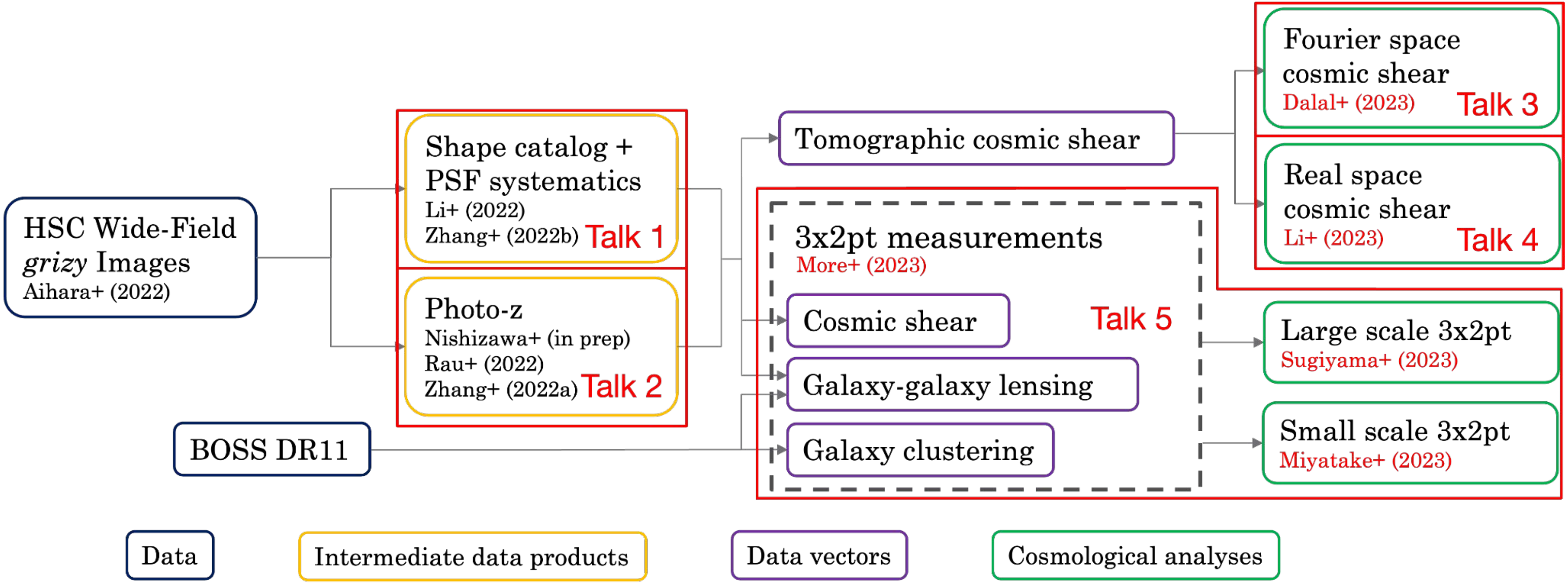
Small scale 3x2pt
Miyatake+ (2023)

Data

Intermediate data products

Data vectors

Cosmological analyses



HSC Wide-Field *grizy* Images
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Shape catalog + PSF systematics
Li+ (2022)
Zhang+ (2022b) Talk 1

Photo-z
Nishizawa+ (in prep)
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Zhang+ (2022a) Talk 2

Tomographic cosmic shear

3x2pt measurements
More+ (2023)

Cosmic shear

Galaxy-galaxy lensing

Galaxy clustering

Talk 5

Fourier space cosmic shear
Dalal+ (2023) Talk 3

Real space cosmic shear
Li+ (2023) Talk 4

Large scale 3x2pt
Sugiyama+ (2023)

Small scale 3x2pt
Miyatake+ (2023)

Data

Intermediate data products

Data vectors

Cosmological analyses

Blind Analysis

We need to avoid **confirmation bias**: we may unconsciously correct systematics to match Planck cosmology.

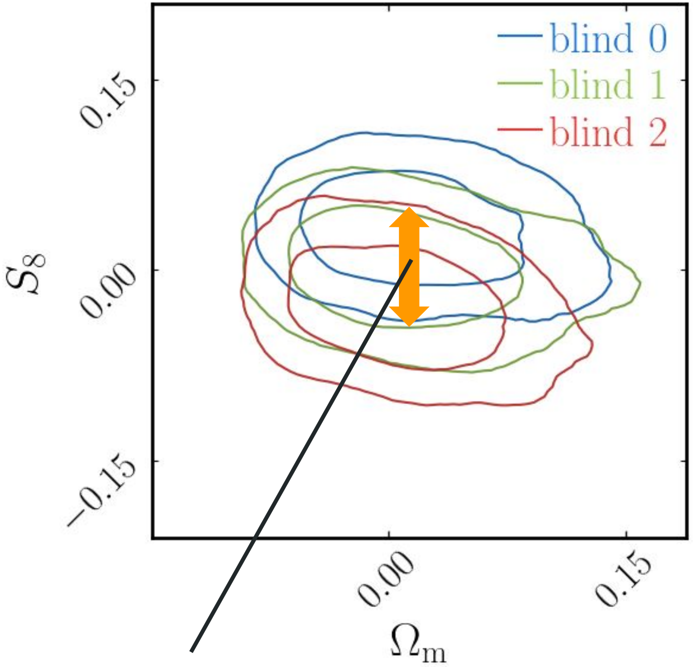
- Catalog-level blinding
  We prepare **three blinded catalogs** with slight offset of WL shear calibration. One of them is the true catalog.
- Analysis-level blinding
  When plotting a contour, we **blind the central value**.

Note: Different sets of blinded catalogs are used for different cosmology analyses.

Systematic tests

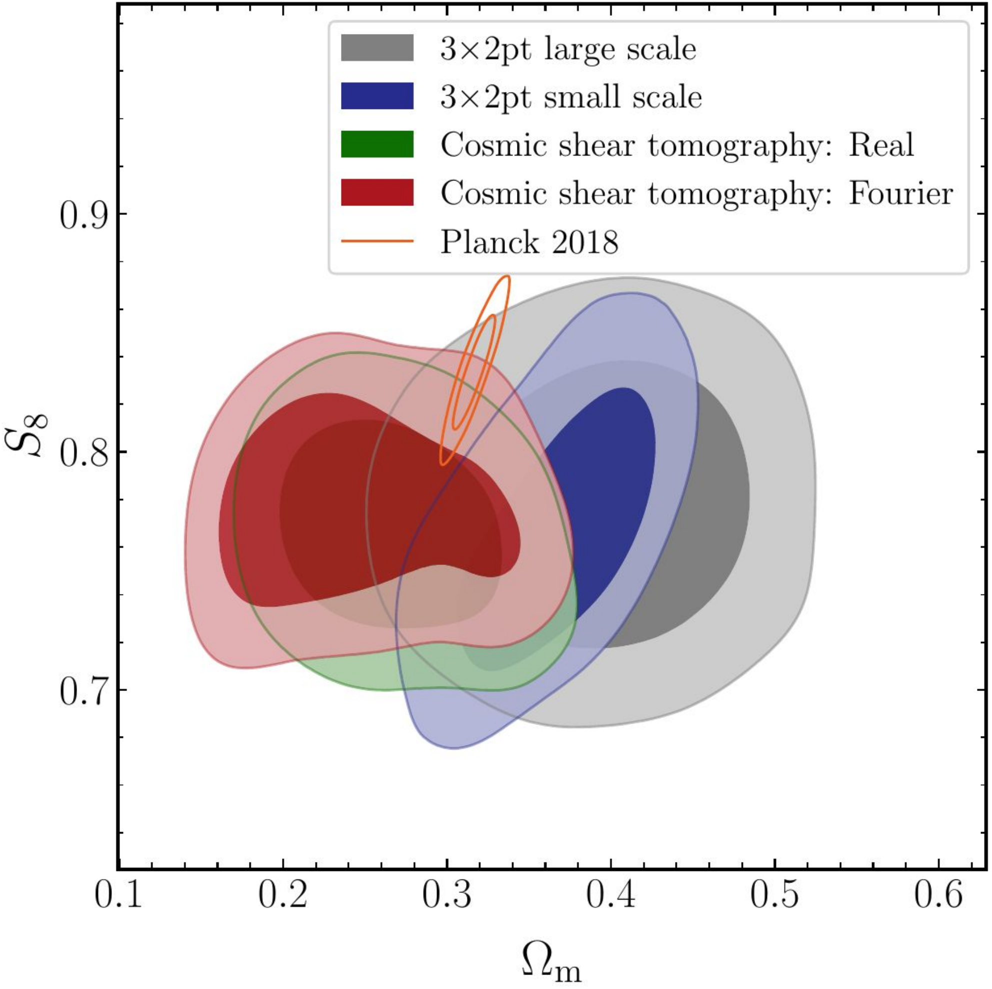
- Stress tests with various analysis choices
  e.g.) scale cuts, model variations, etc…

Unblind!



$$|\Delta S_8| \simeq 0.1 > |S_{8,\mathrm{CMB}} - S_{8,\mathrm{LSS}}|$$

Unblinded on Feb 16, 2023!



Sugiyama+ (2023)
Miyatake+ (2023)
Li+ (2023)
Dalal+ (2023)

The HSC Year 3 Shear Catalog

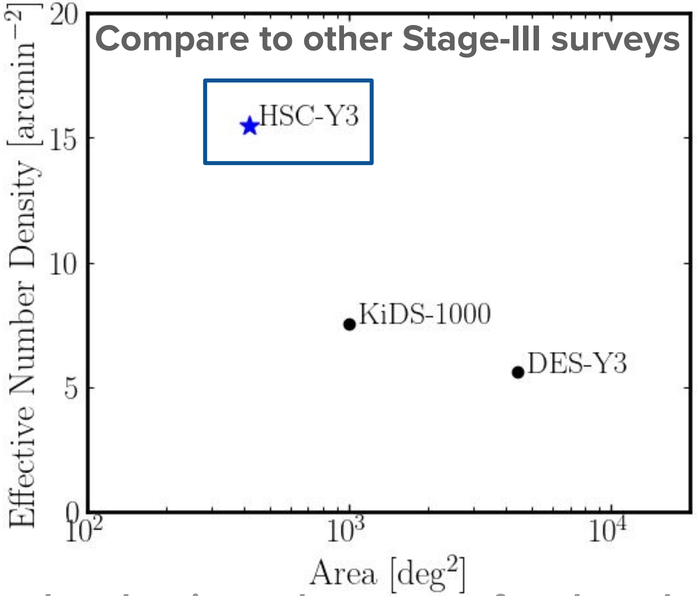
Xiangchong Li (Carnegie Mellon University)

HSC-Y3 shape catalog

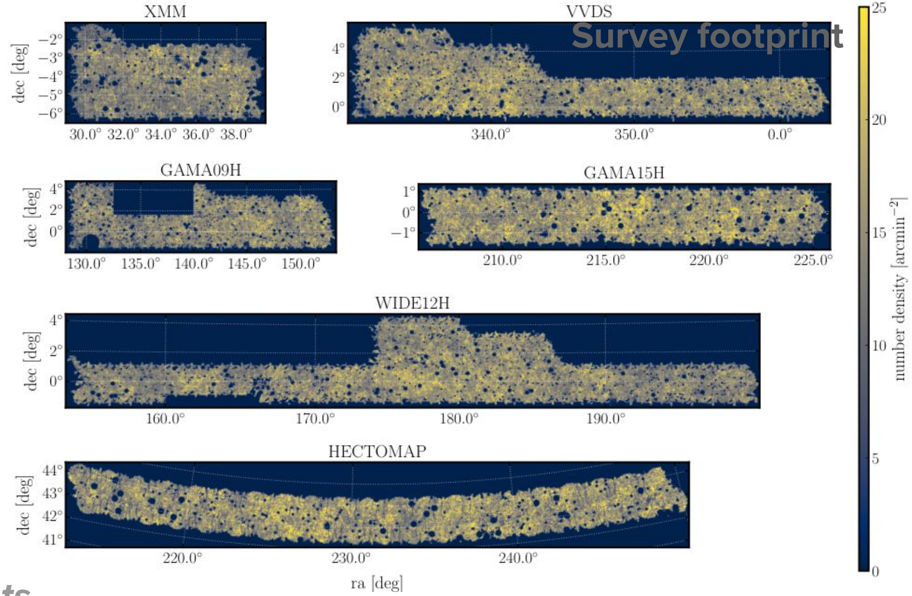
1. We measure shear from shapes of 25 million galaxies;
2. The shear estimation is tested and calibrated with realistic image simulations (next slide);
3. We correct for PSF systematics in estimated shapes (next slide).

Using i-band HSC images

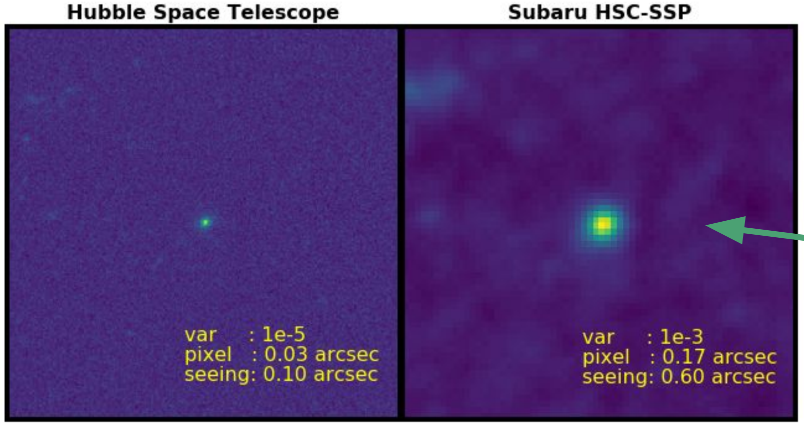
Magnitude cut:	24.5
Area:	416 (square degree)
number density:	~16 (/ square arcmin)
Seeing size:	0.6 arcsec
Shape noise:	0.236 (per-component)


Compare to other Stage-III surveys

The number density and area are after the selection cuts.


Survey footprint

Calibrate shape estimation with image simulation



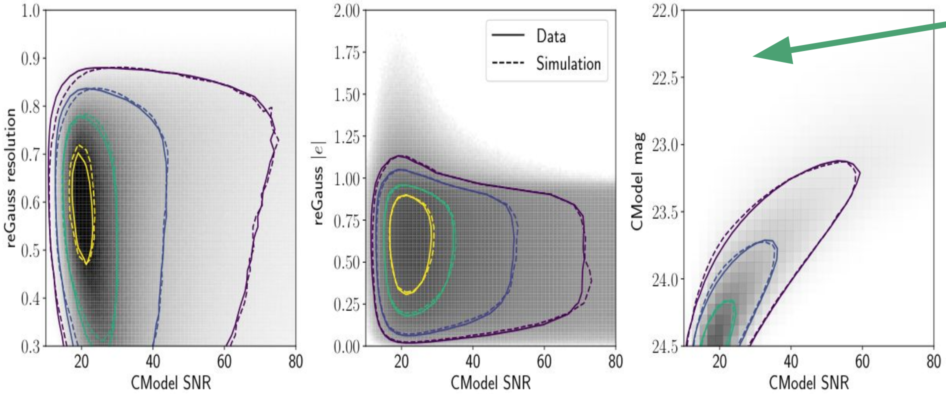
$$\boxed{\hat{\gamma}} = (1+\boxed{m})\boxed{\gamma}+\boxed{c}$$

Measured shape

input shape

Quantify **biases** with **image simulations**.

Mandelbaum+ (2018), Li+ (2022)



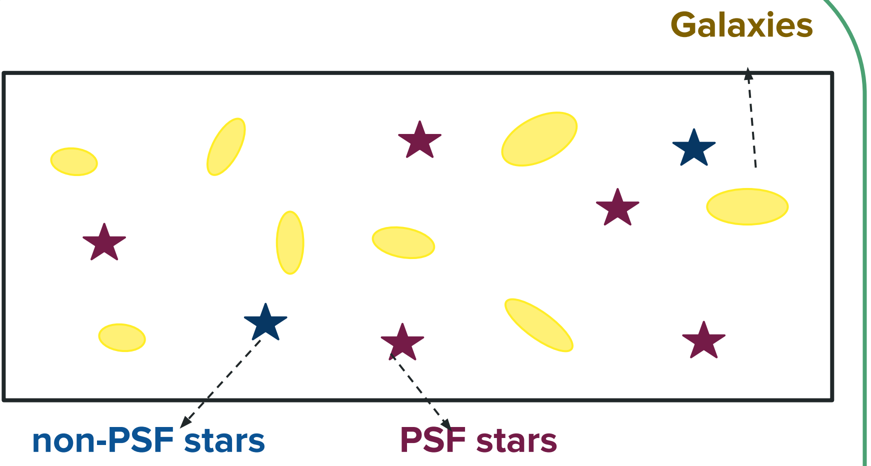
1. We use galaxy image simulations (downgrading the high-resolution Hubble Space Telescope **(HST)** images to the HSC observational conditions) to calibrate our shape estimation;

2. Our simulation matches the galaxy number histogram with an accuracy of **1%.**

3. **The image simulation describes the i-band images well; therefore, we believe we have controlled many systematic errors and produced a science-quality catalog.**

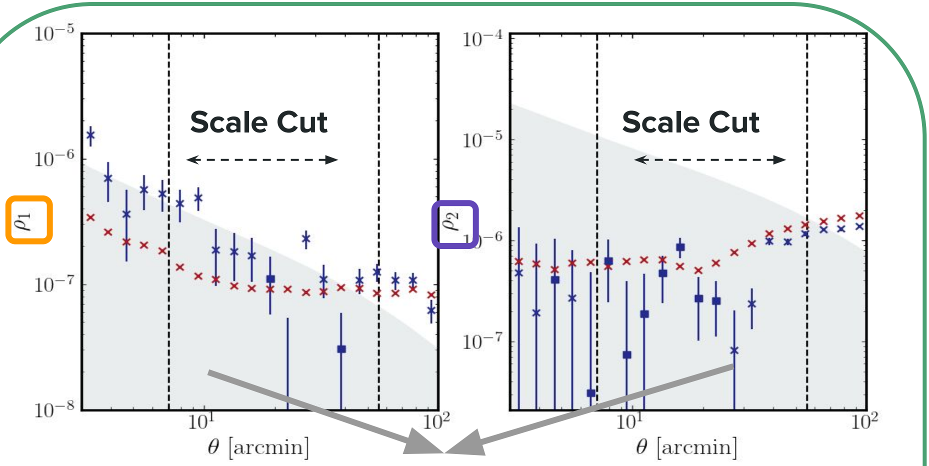
PSF Modeling and Validation

Zhang+ (2022), Li+ (2022)



Modeling:

1. Use **star images** to interpolate Point-Spread Functions (PSFs) for **galaxies**;
2. Reserved **non-PSF stars** to test PSF model;



Requirement: systematics < 0.25 σ

Testing:

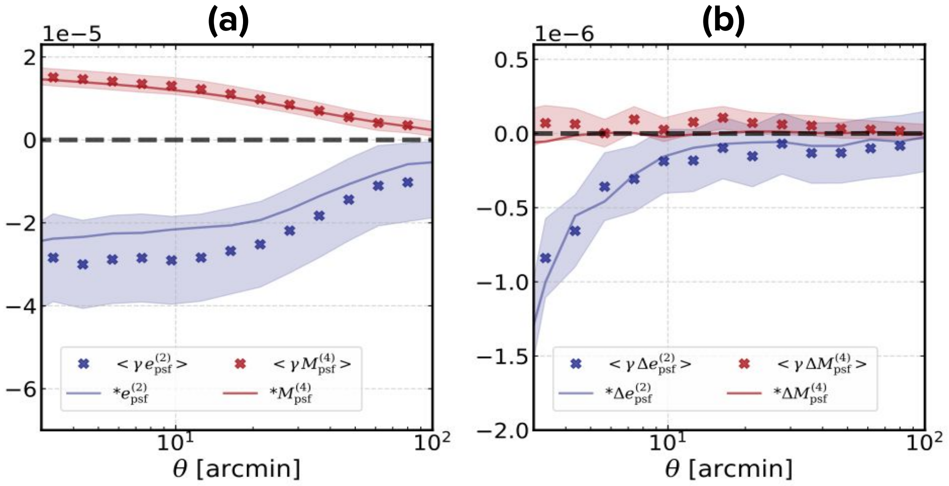
1. Validate the PSF models by comparing the image of stars and PSF models derived from the interpolation.
2. ρ_1 : shape residual **x** shape residual
3. ρ_2 : shape residual **x** shape

The PSF shape error is comparable to our requirement; therefore, we must model and marginalize it in our cosmology analysis.

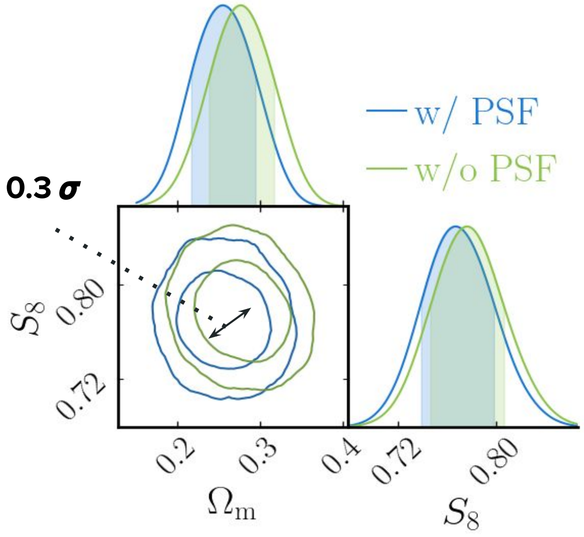
Marginalizing over PSF systematics

Cross-correlating the galaxy shapes with **(a)** star shape, and **(b)** star shape residuals — non-zero correlation indicates PSF systematics in galaxy shapes.

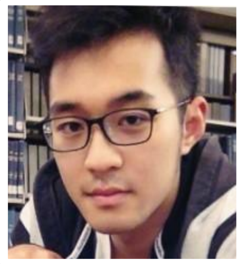
e: 2nd order star shape; M: 4th order star shape



1. **Cosmology constraint with marginalizing PSF systematics**
2. **Cosmology constraint without marginalizing PSF systematics**



We model and marginalize over PSF systematics from second- and higher-order PSF shapes and shape residuals.



Source Redshift Distribution Inference

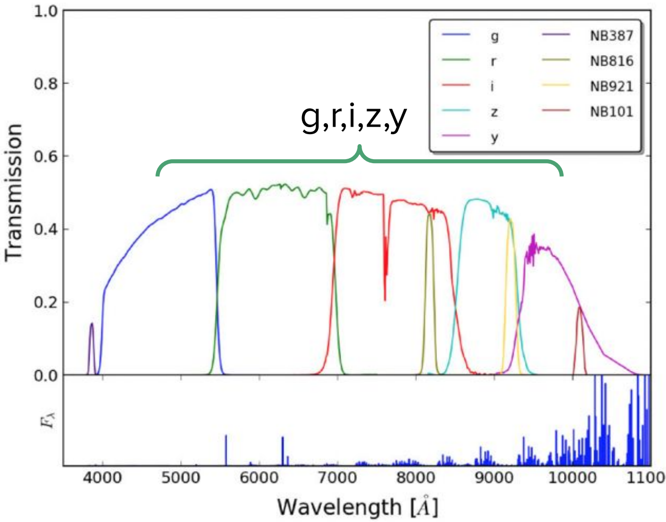
Tianqing Zhang (Carnegie Mellon University)

Overview

Redshift of the HSC Y3 source catalog is estimated by the photometry (photo-z).

Photometric redshift-related work for the HSC Y3 cosmology was as follows:

- A variety of template-fitting (Mizuki) and empirical methods (DEmPz and DNNz) to estimate photo-z, and calibrate the photo-z by external datasets. (Nishizawa et al. *in prep*)
- Redshift distribution inference for our 3x2pt and cosmic shear analysis (See Rau et al. 2022)
- Modeling choice for photo-z uncertainty marginalization is studied in Zhang et al. 2022.



HSC filter bandpasses

Rau+2022

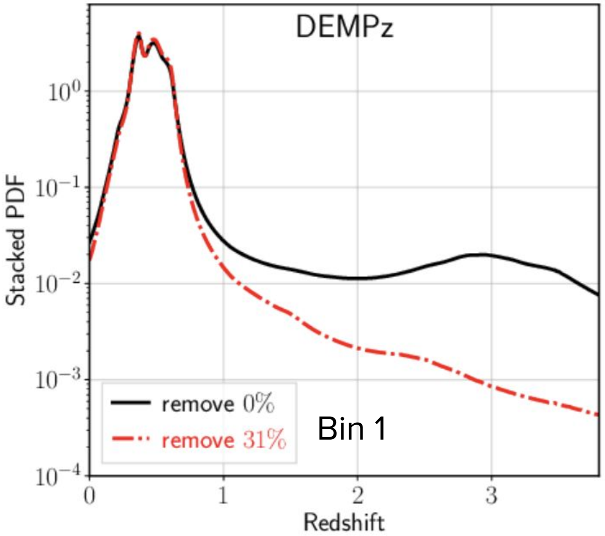
Redshift distribution inference

For the HSC Y3 cosmic shear analysis, the source galaxies are divided into 4 tomographic bins based on DNNz: [0.3-0.6], [0.6-0.9], [0.9-1.2], [1.2-1.5].

We remove galaxies with double peak in their photo-z probability density functions (PDFs)

The redshift distribution inference combines:

- Photo-z PDFs
- Cosmic variance
- Line-of-sight cross-correlation with CAMIRA (a red-sequence technique) Luminous Red Galaxies (LRGs)



Double-peak removal before (black) and after (red) for the first bins

Rau+2022

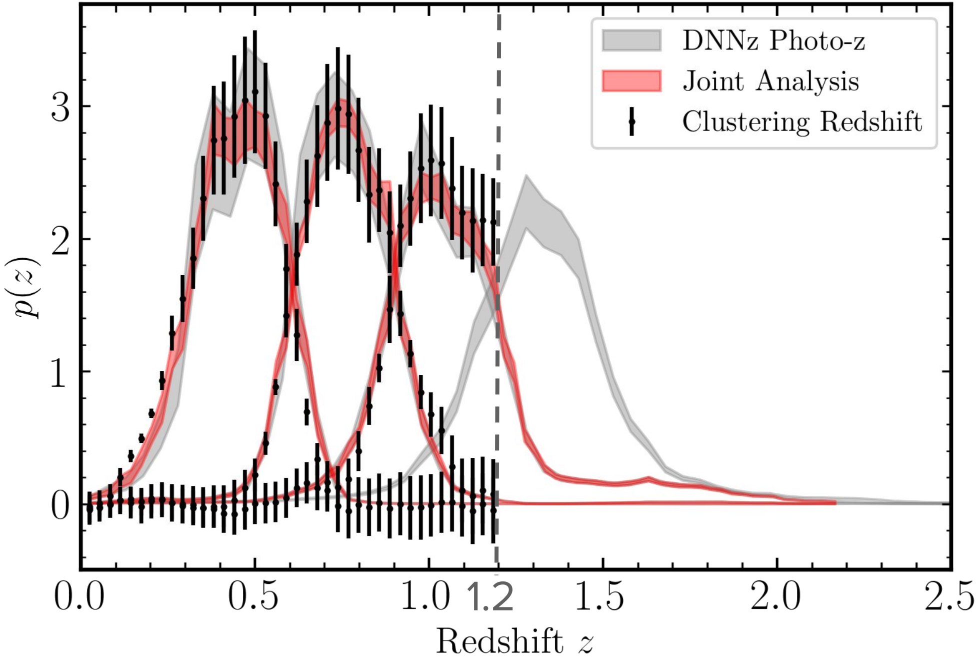
Redshift distribution inference

Grey: photo-z likelihood (DNNz) + cosmic variance

Clustering Redshift: cross-correlation between HSC source catalog and CAMIRA-LRG

Red: joint posterior of the two

Source galaxies with z>1.2 are <u>not</u> calibrated by CAMIRA-LRG samples.



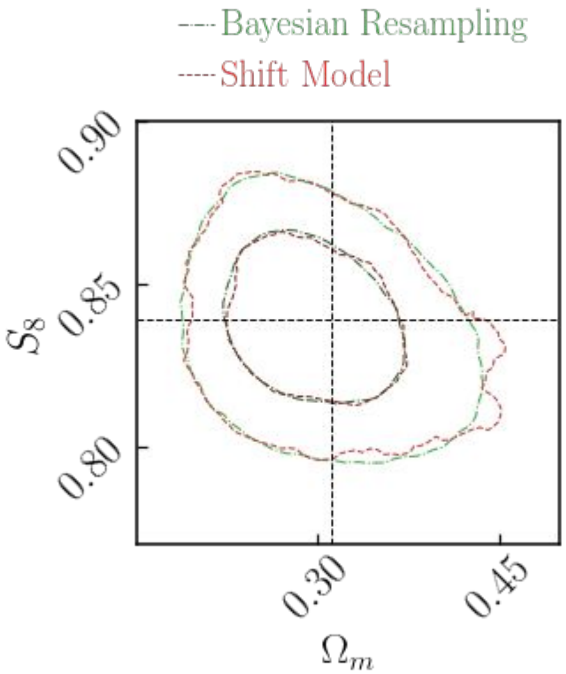
Zhang+2022

Redshift uncertainty marginalization

We conducted two validation tests to ensure that the mean-shift model is well suited for redshift uncertainty marginalization for HSC Y3:

1. Compare mock parameter constraints mean-shift model with a more sophisticated method, which marginalizes over the full uncertainty.
2. Statistical coverage test for the mean shift model on S_8.

<u>Conclusion: mean-shift model works well for HSC Y3 purposes</u>



Mock test for redshift uncertainty marginalization for HSC Y3 (real space)

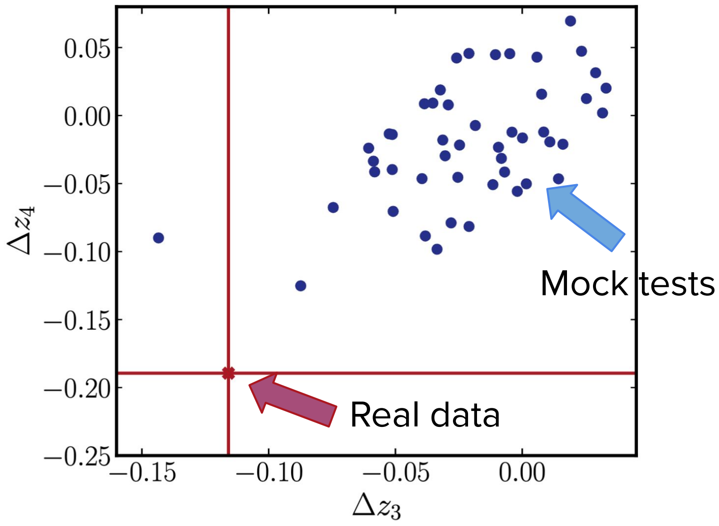
Redshift prior choice for cosmological analyses

Rau+2022
Li+2023
Dalal+2023
Sugiyama+2023

For Δz_1 and Δz_2, we choose Gaussian priors that combine the uncertainties of DNNz and DEmPz, and their difference.

For Δz_3 and Δz_4, we found potential inconsistency in the informative prior versus posterior using a flat prior [-1,1].

- We use a mock test to show that the shift in Δz_3 and Δz_4 is statistically significant. Therefore, we use a flat prior for Δz_3 and Δz_4, as well as Δz in the 3x2pt analysis.



Comparing statistical spread of Δz3 and Δz4, versus the shift using a flat prior. (real space)

Cosmology from Cosmic Shear Power Spectra

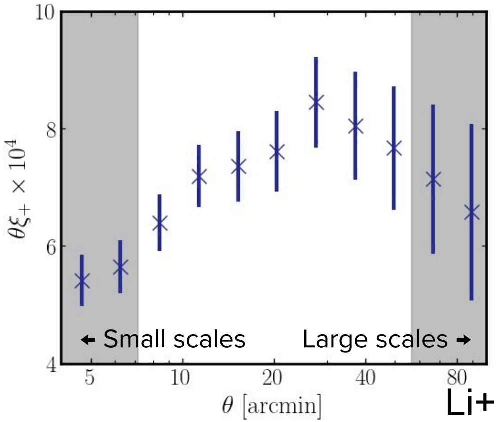
Roohi Dalal (Princeton University)

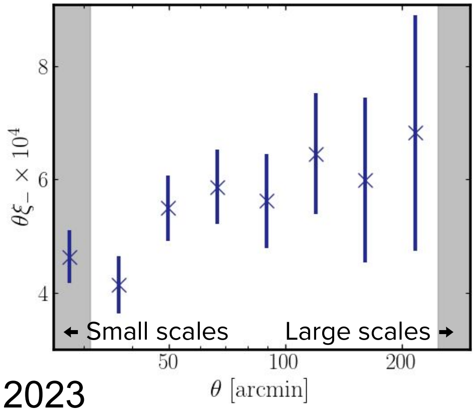
Cosmic Shear Measurements

When constructing cosmic shear data vectors, two methods we can use are:

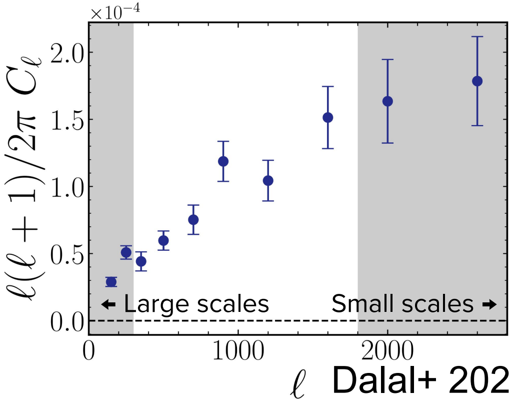
- $\xi_{\pm}(\theta)$ (2 Point Correlation Functions) - measures the correlation of shapes of galaxies with an angular separation θ.
- C_{ℓ} (Angular Power Spectrum) - measures the second moment of the Fourier transform of the shear field, as a function of multipole (ℓ).

Cosmic shear measurements for the HSC-Y3 highest redshift bin:





Li+ 2023



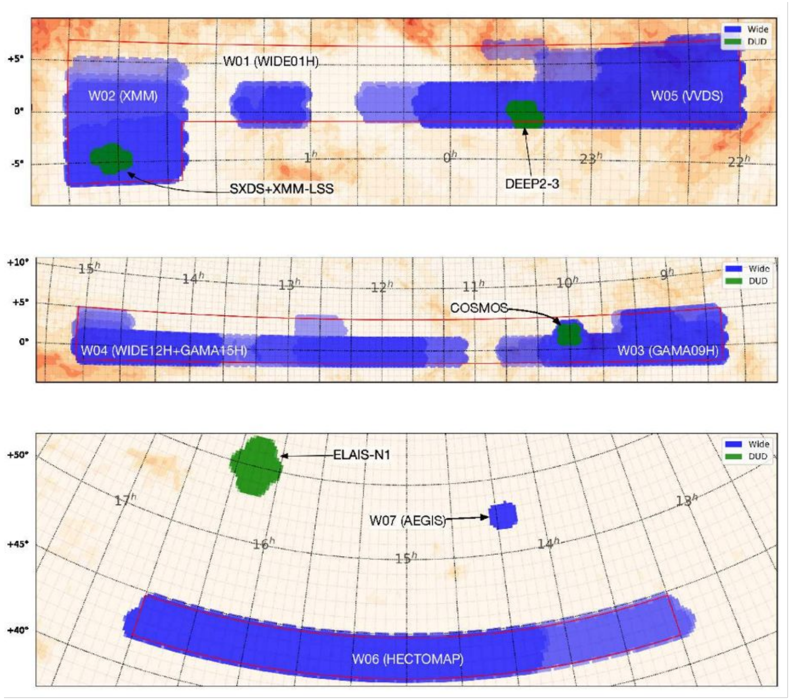
Dalal+ 2023

Cosmic Shear Power Spectrum Measurements

- Use NaMaster (Alonso+2019) to correct for biases due to partial sky coverage (Pseudo-C_ℓ).
- Measure 10 auto- and cross-correlation power spectra for 4 tomographic redshift bins between z=0.3 and z=1.5.
- Fiducial scale cuts: $300 \leq \ell \leq 1800$.

Due to evidence of systematics contamination at large scales.

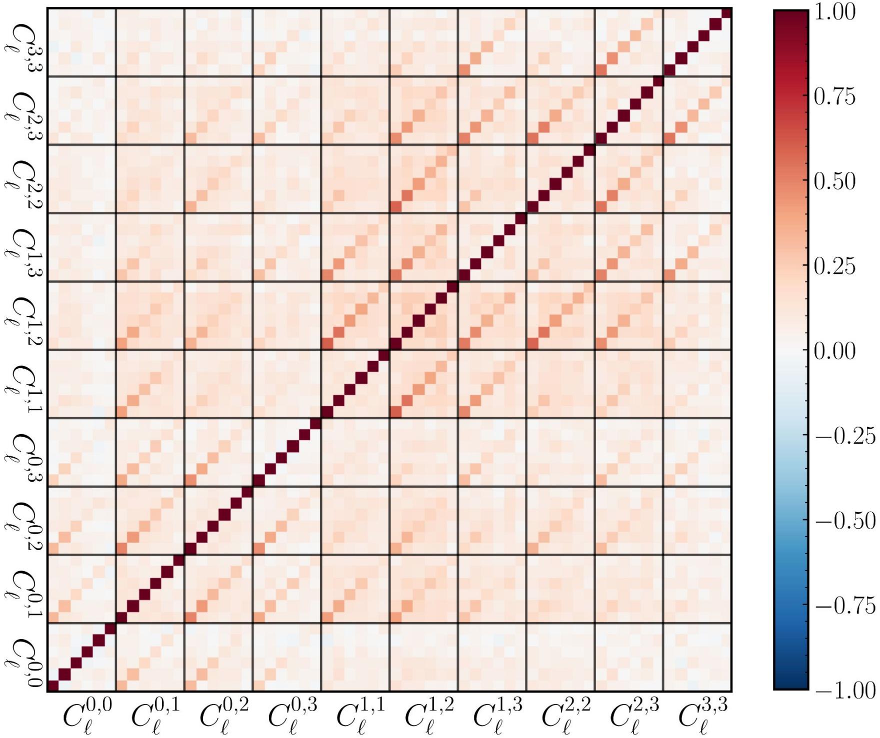
Due to uncertainties in baryonic feedback and intrinsic alignments.



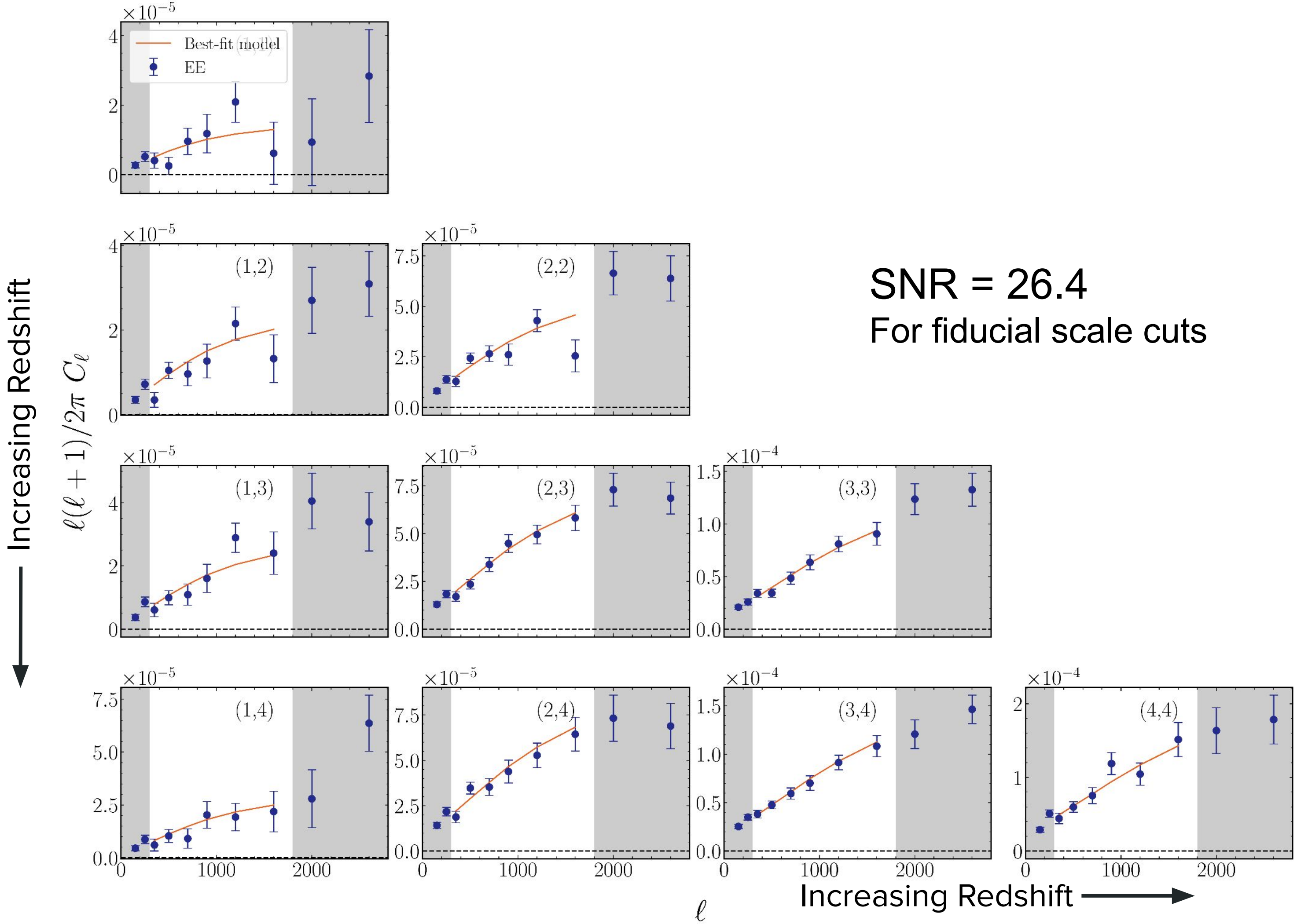
HSC Y3 consists of six different fields on the sky, leading to a complicated survey geometry which we correct for with NaMaster.

Covariance measurement

Covariance measured using 1404 mock catalogs, which use actual HSC-Y3 galaxy positions, and apply a lensing signal based on the ray-tracing simulations from Takahashi+ (2017).

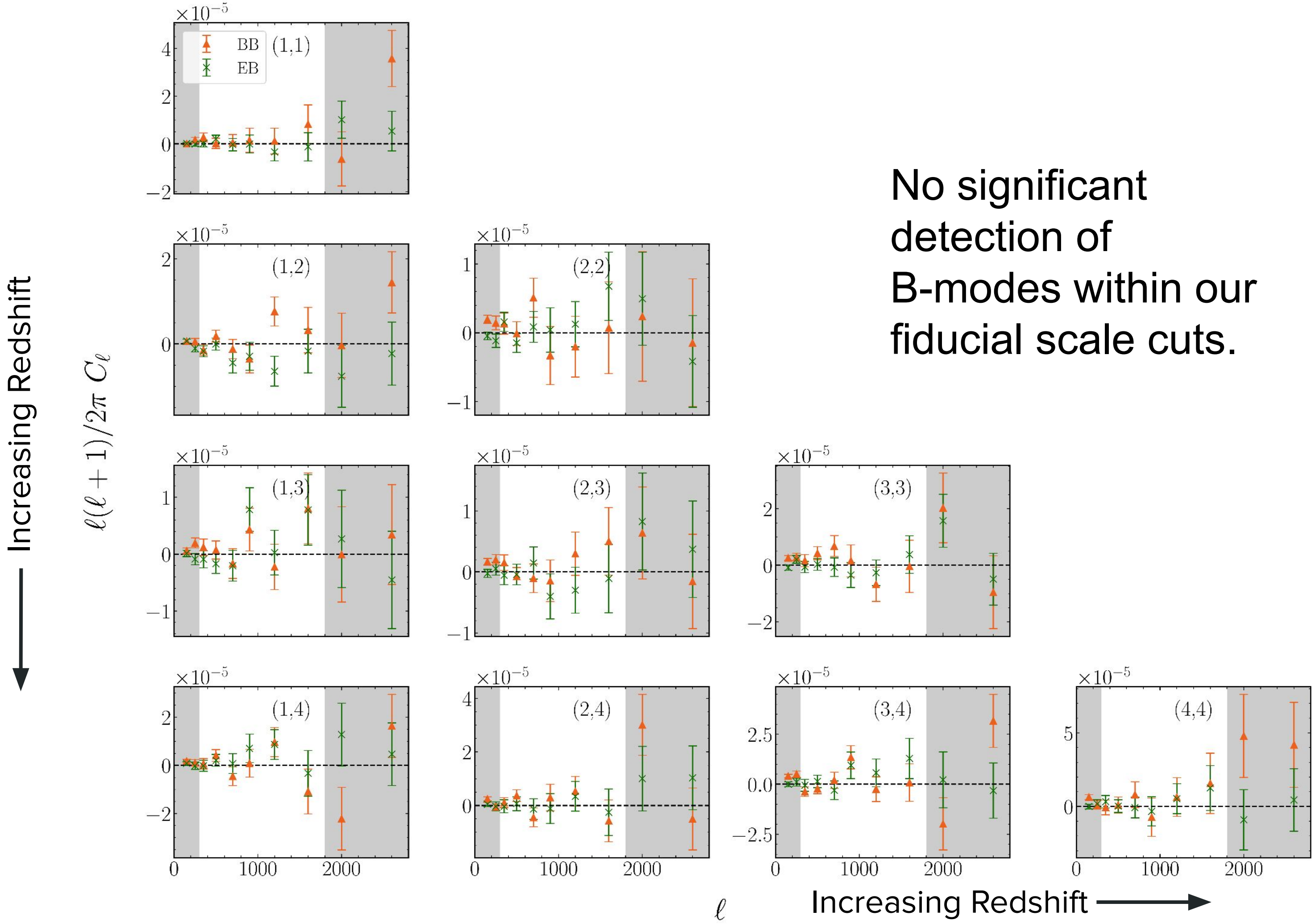


Correlation Matrix



SNR = 26.4

For fiducial scale cuts



No significant detection of B-modes within our fiducial scale cuts.

From data to cosmological constraints

$$-2\ln\mathcal{L}(\hat{C}_\ell\,|\,\Theta) = \left(\hat{C}_\ell - C_\ell(\Theta)\right)^{\mathrm{T}} \mathbf{C}^{-1} \left(\hat{C}_\ell - C_\ell(\Theta)\right)$$

Observed data

Theory prediction

Covariance

Our power spectrum model is based on 23 parameters (5 cosmological, 6 astrophysical, 12 observational systematics). The model accounts for:

- Astrophysical effects
  - Baryonic feedback (HMCode 2016, Mead+ 2016)
  - Intrinsic alignments (TATT, Blazek+ 2019)
- Systematics in the data
  - Point Spread Function systematics (Zhang+ 2022b)
  - Redshift distribution uncertainties (Zhang+ 2022a)
  - Shear calibration biases

We evaluate the likelihood throughout our parameter space using the PolyChord nested sampling algorithm (Handley+ 2019), implemented in CosmoSIS (Zuntz+ 2015).

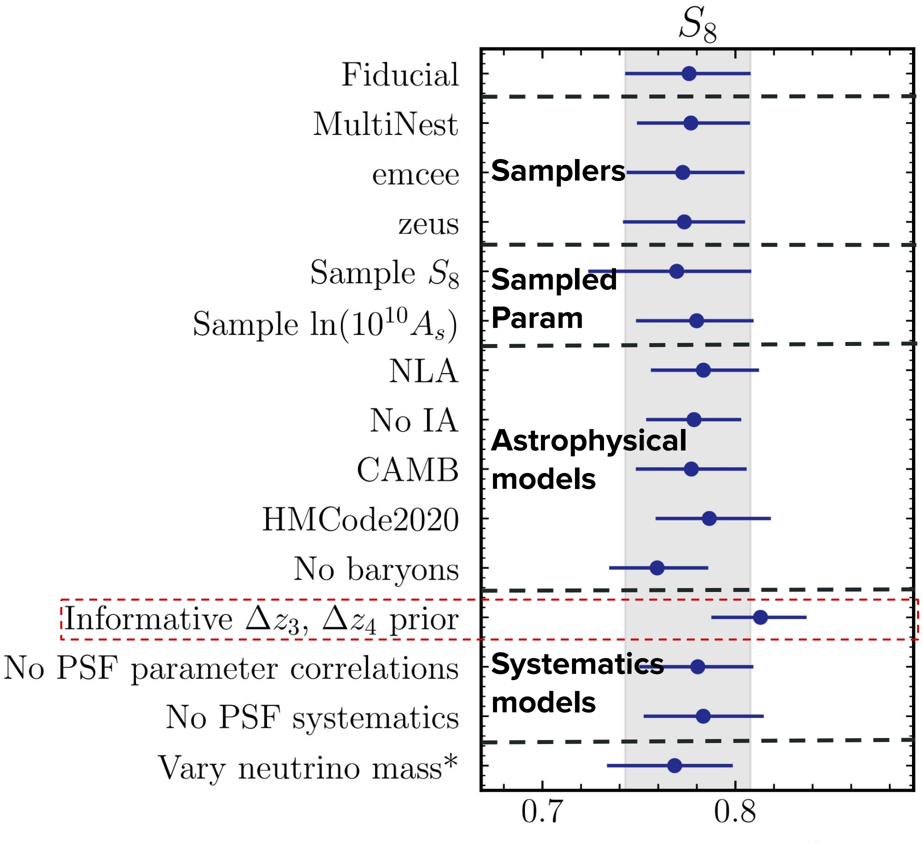
A 4% precision constraint on S_8:

$$S_8 = 0.776^{+0.032}_{-0.033}$$

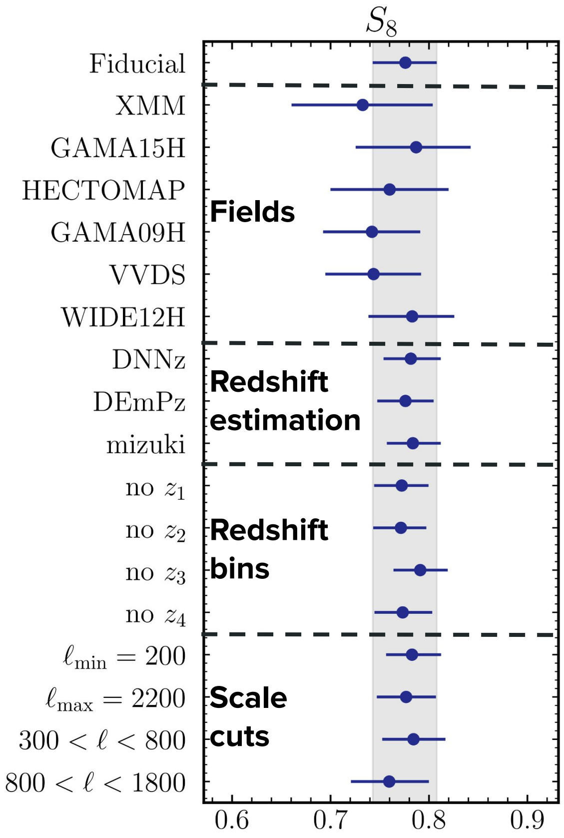
p-value of best-fit model: 0.42

Pre-unblinding consistency tests show our results are robust.

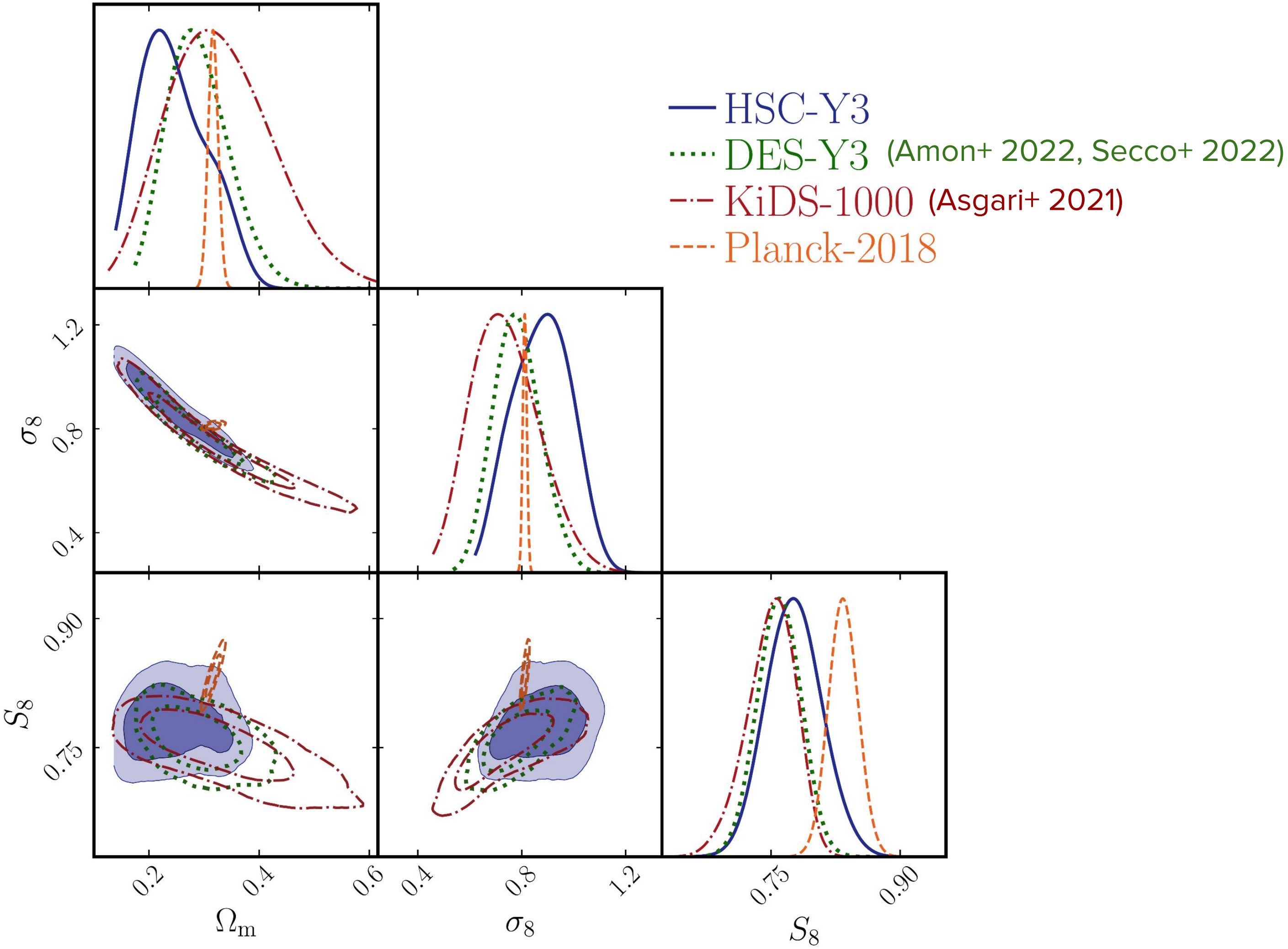
The informative prior test appears to be revealing a real issue with the high redshift N(z), fixed by the uninformative prior used in the fiducial analysis.



Modeling and Analysis Choices



Internal consistency

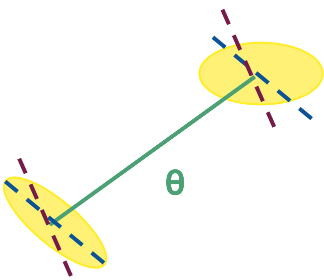

HSC-Y3
DES-Y3 (Amon+ 2022, Secco+ 2022)
KiDS-1000 (Asgari+ 2021)
Planck-2018
σ_8
1.2
0.8
0.4
S_8
0.90
0.75
0.2
0.4
0.6
Ω_m
0.4
0.8
1.2
σ_8
0.75
0.90
S_8

Cosmology from Cosmic Shear Two Point Correlation Functions

Xiangchong Li (Carnegie Mellon University)

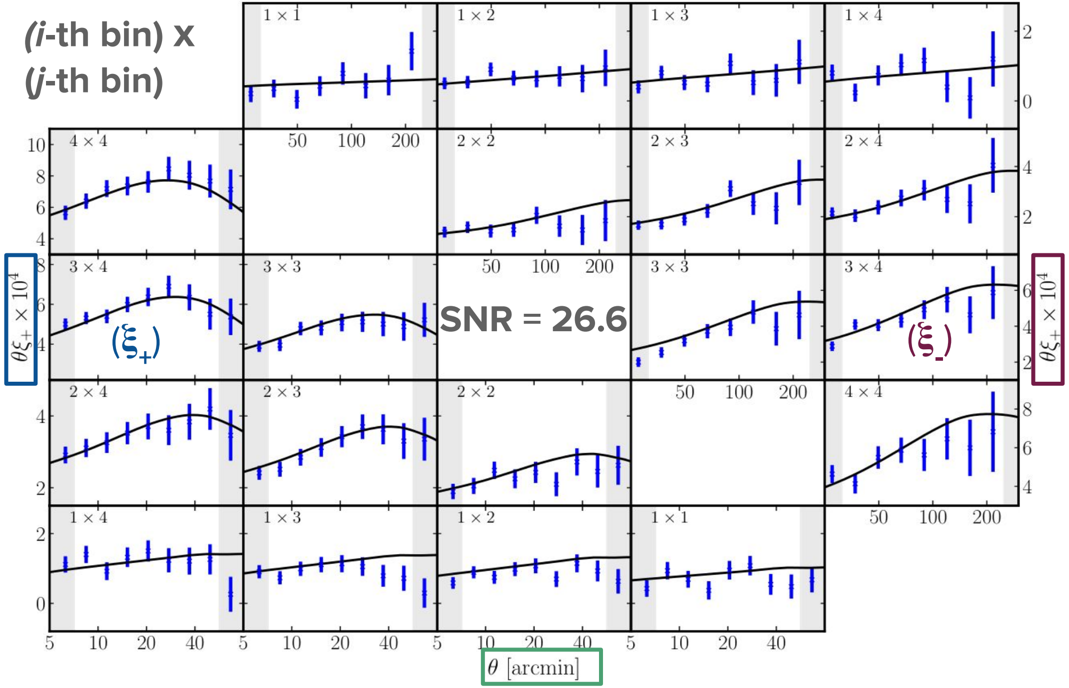
Measurement and Covariance

1. We perform **Real space** and **Fourier space** analyses, which are complementary to each other since they emphasize **different scales**;
2. Modeling choices are coordinated between **Real space** and **Fourier space** analyses;

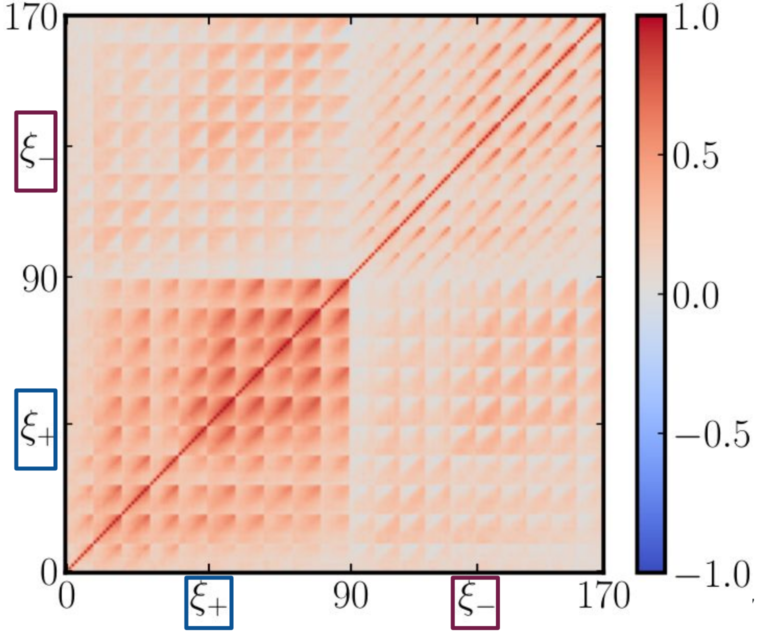


1. **2D Shapes** have **Magnitudes and Angles (2 components)**
2. **Tangential correlation(ξ_+)**
3. **45 degree correlation (ξ_-)**

$\xi_\pm(\theta)$ (2 Point Correlation Functions)

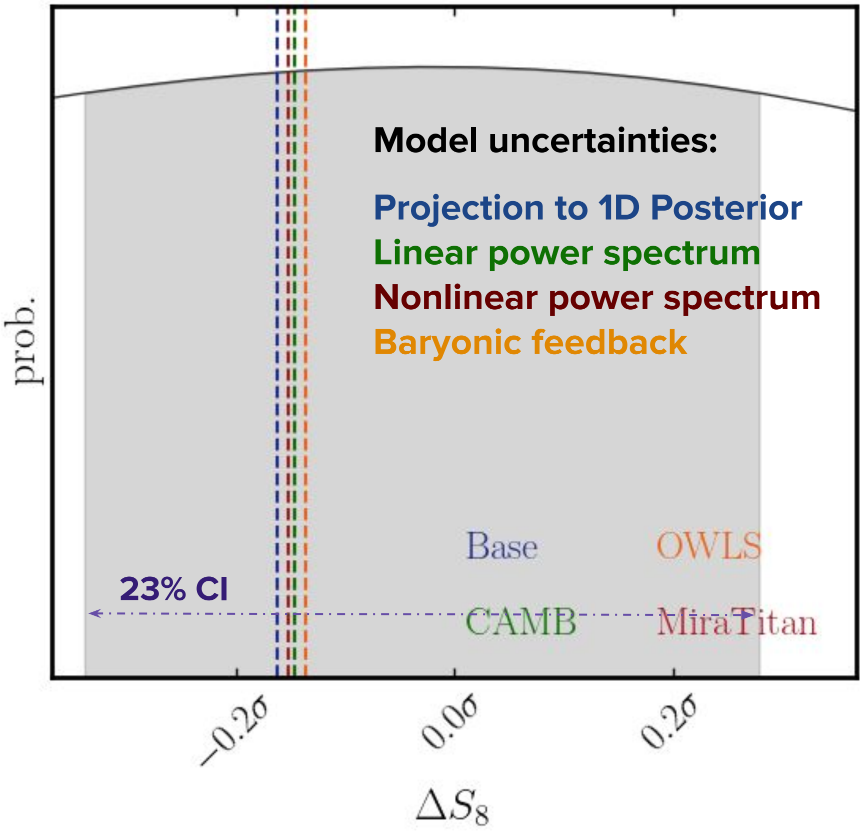


Cov($\xi_\pm(\theta)$, $\xi_\pm(\theta)$)



Cosmology Constraint

1. Mock Tests



Model uncertainties:

Projection to 1D Posterior
Linear power spectrum
Nonlinear power spectrum
Baryonic feedback

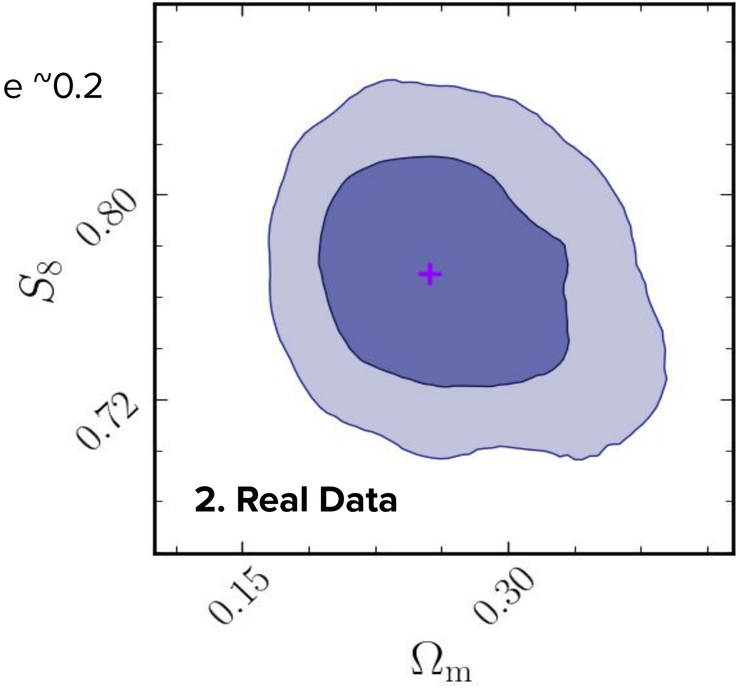
23% CI

$$\Omega_\mathrm{m} : \quad 0.256^{+0.056}_{-0.044}$$

$$\sigma_8 : \quad 0.818^{+0.089}_{-0.091}$$

$$S_8 : \quad 0.769^{+0.031}_{-0.034}$$

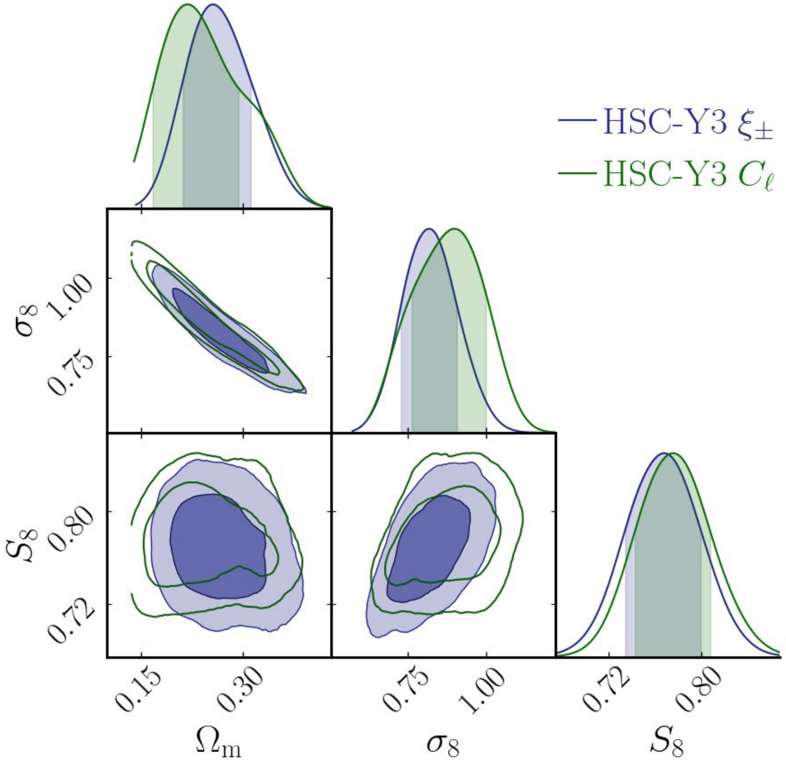
p-value ~0.2



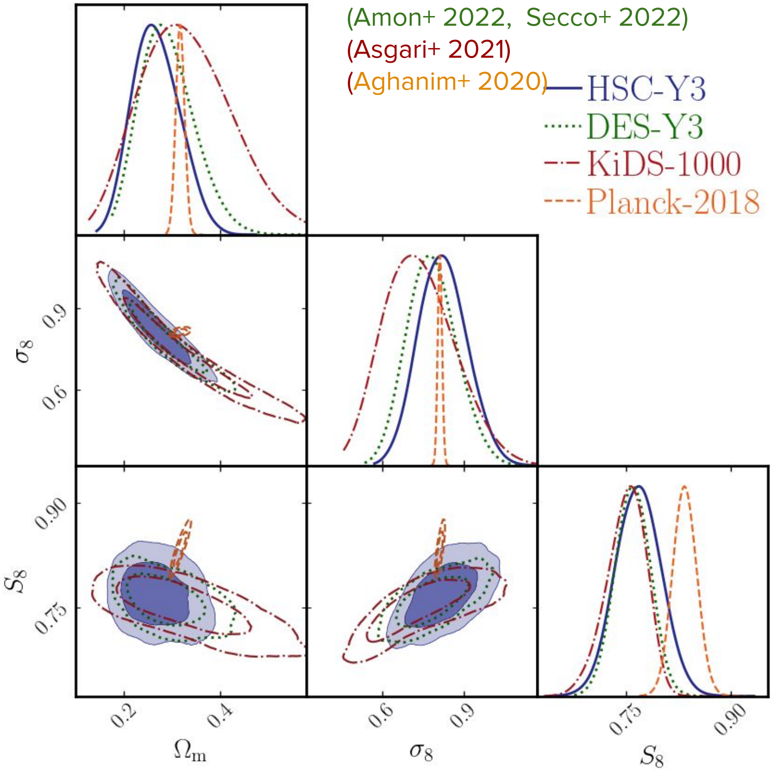
2. Real Data

Comparison with Fourier Space analysis and Other Observations

Real space and Fourier space analyses are consistent with each other. Note that the two analyses rely on different scales.



Our analysis is consistent with other weak-lensing analyses but has a **2σ** tension with ***Planck-2018***

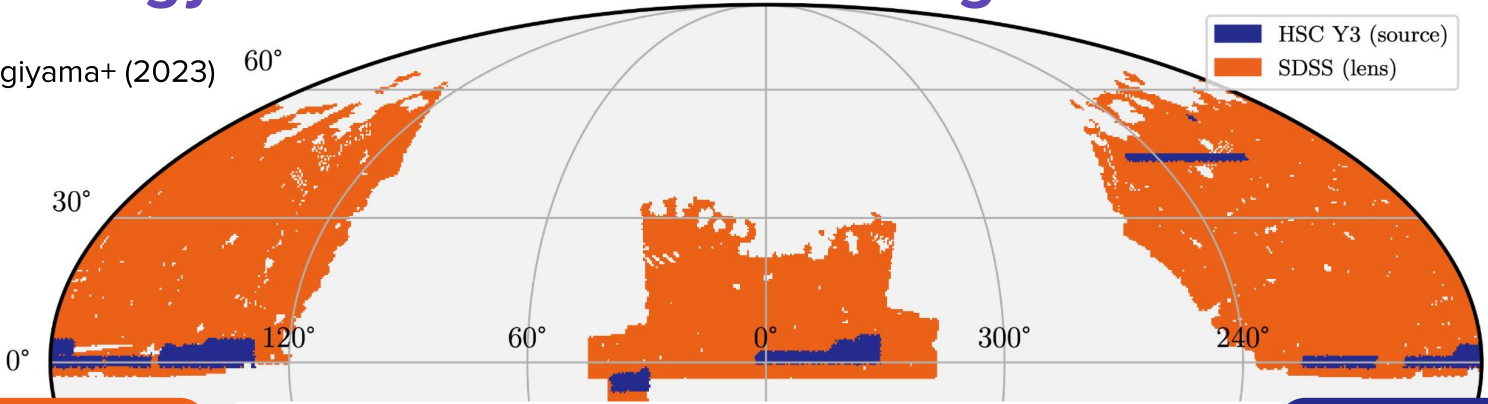

(Amon+ 2022, Secco+ 2022)
(Asgari+ 2021)
(Aghanim+ 2020)

Cosmology from 3x2pt Analyses

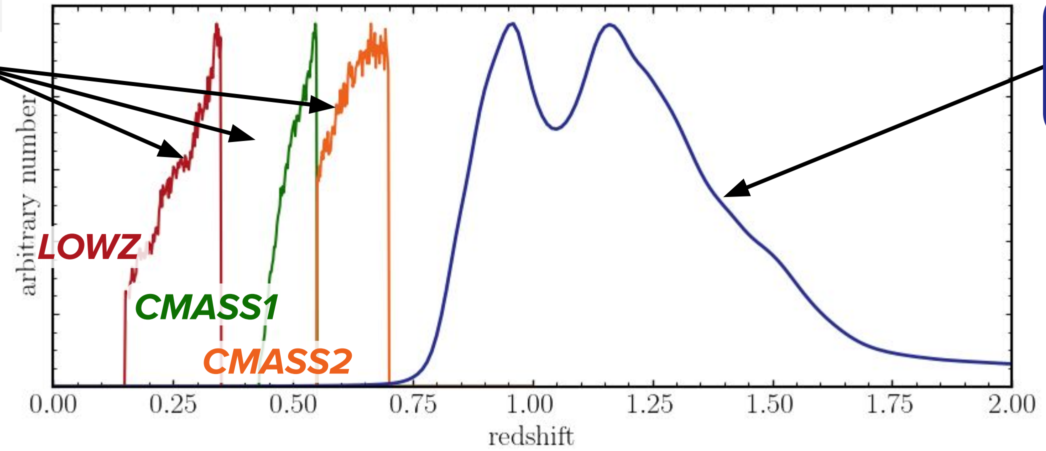
Sunao Sugiyama (Kavli IPMU)

Cosmology with HSC x SDSS catalogs

More, Sugiyama+ (2023)



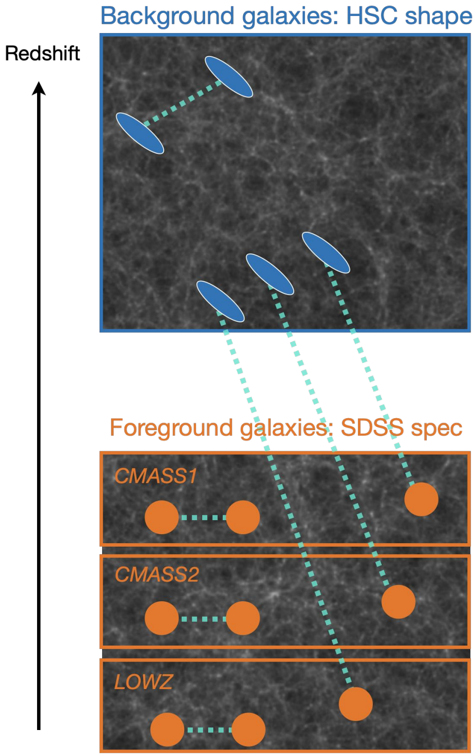
SDSS spec-z sample lens galaxies

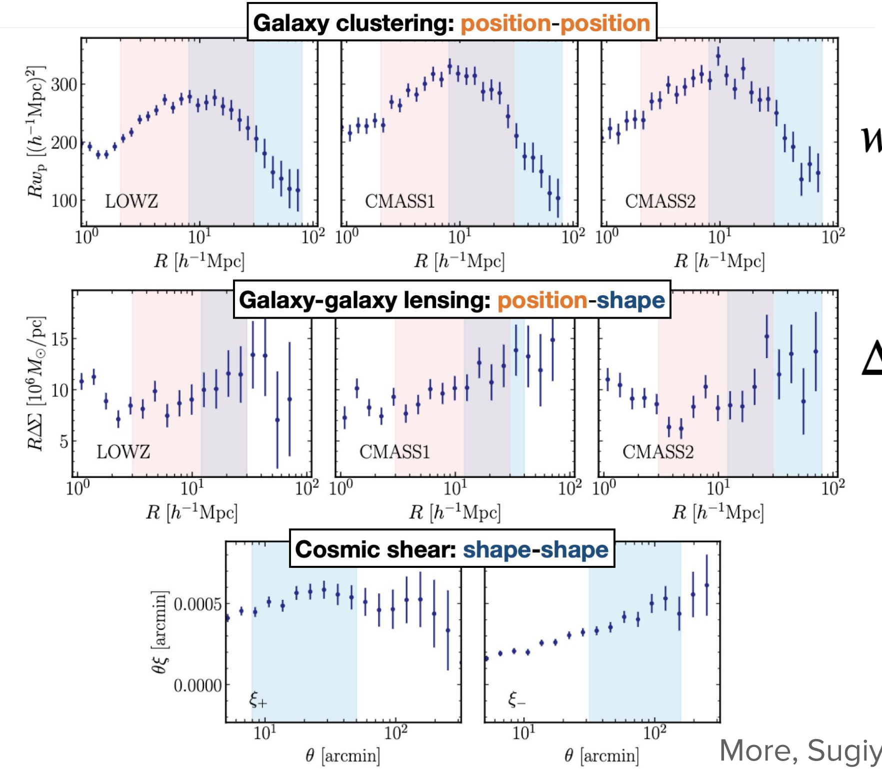


HSC shape sample source galaxies

Single source sample for 3x2pt analysis, which is different from tomographic cosmic shear source samples.

3x2pt analysis with HSC x SDSS catalogs




Galaxy clustering: position-position

Galaxy-galaxy lensing: position-shape

Cosmic shear: shape-shape

More, Sugiyama+ (2023)

$\delta_\mathrm{g} = b\delta_\mathrm{m}$ on large scales

$$w_\mathrm{p} \sim b^2 \xi_\mathrm{mm}(r \,|\, \Omega_\mathrm{m}, \sigma_8)$$

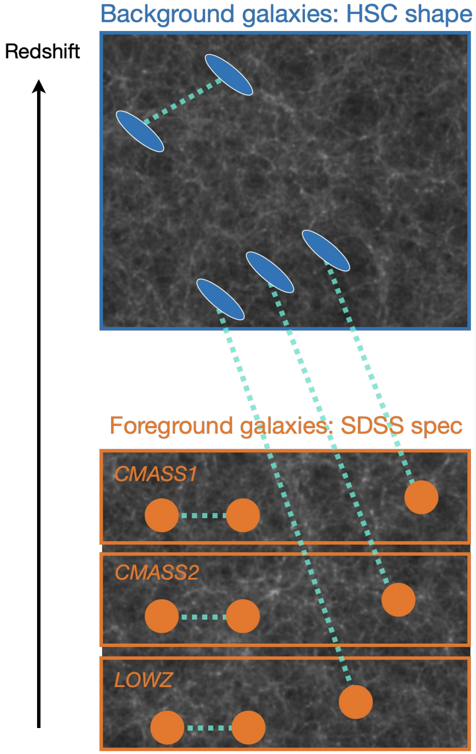
$$\Delta\Sigma \sim b \xi_\mathrm{mm}(r \,|\, \Omega_\mathrm{m}, \sigma_8)$$

$$\xi_\pm \sim \xi_\mathrm{mm}(r \,|\, \Omega_\mathrm{m}, \sigma_8)$$

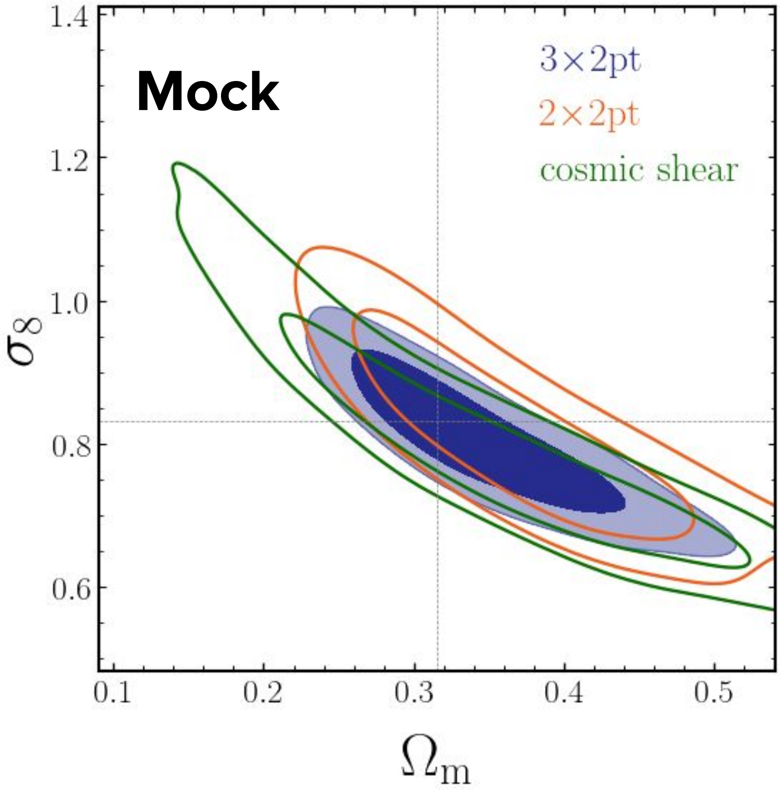
The data vector passed systematics tests in the scales shown by shaded region. These scales were used for the 3x2 pt cosmology analyses.

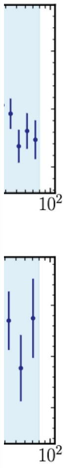
Credit: T. Nishimichi,
edited by S. Sugiyama

3x2pt analysis with HSC x SDSS catalogs



Credit: T. Nishimichi,
edited by S. Sugiyama





$\delta_g = b\delta_m$ on large scales

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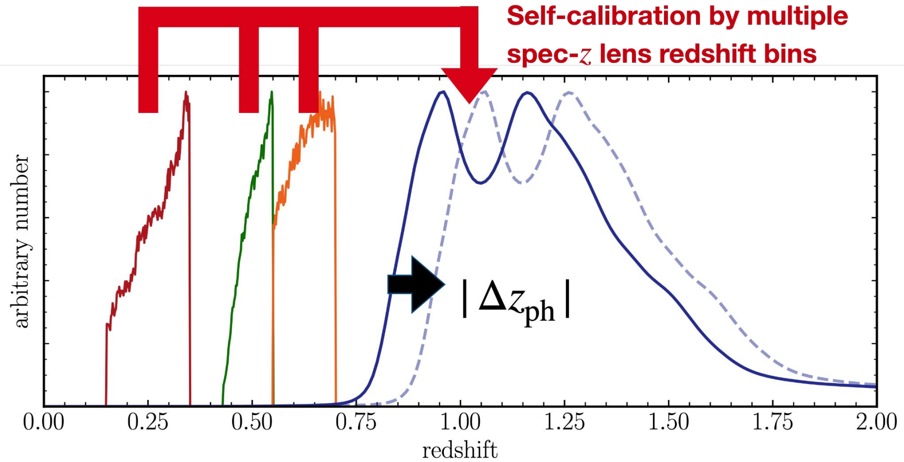
$$\xi_\pm \sim \xi_{mm}(r\,|\,\Omega_m, \sigma_8)$$

, Sugiyama+ (2023)

les shown by shaded region.

These scales were used for the 3x2 pt cosmology analyses.

Photo-z calibration by multiple spec-z lens redshift bins



3x2pt source samples are at high redshift $z \gtrsim 1$, where

- photometric redshift estimate may be inaccurate,
- Cross calibrators (CAMIRA-LRGs) are not available.

Conventional approach:

Informative Gaussian prior with $\sigma(\Delta z_{\rm ph}) \sim 10^{-2}$

Our approach:

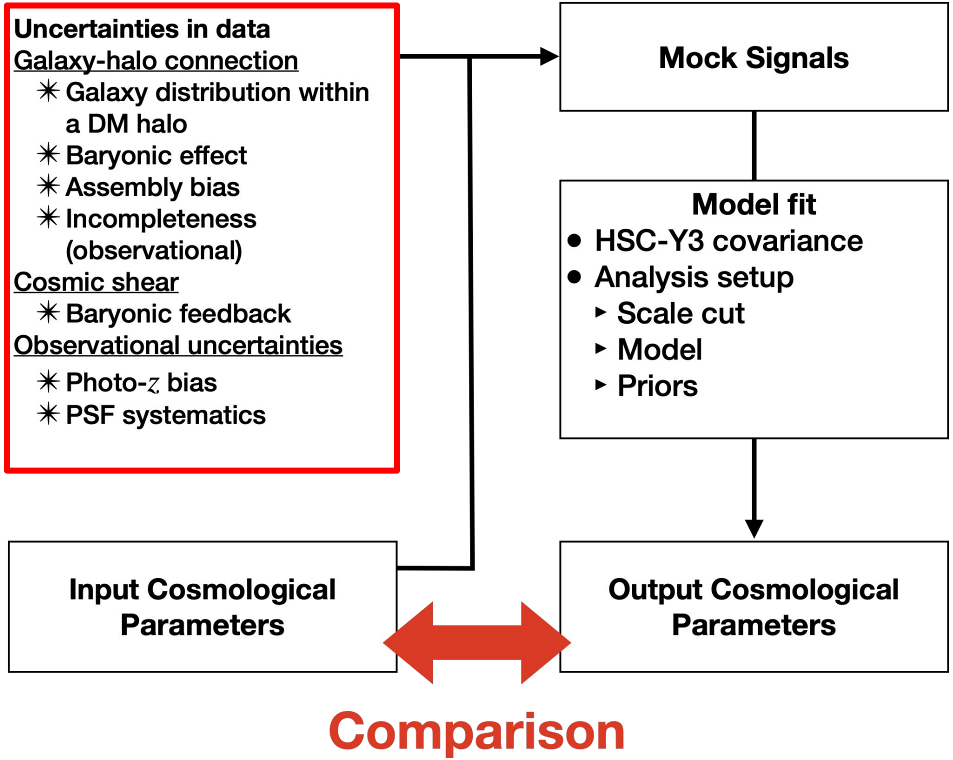
We adopt uninformative prior for the residual error in mean redshifts of our source sample:

$$\Pi(\Delta z_{\rm ph}) = \mathcal{U}(-1,1)$$

$\Delta z_{\rm ph}$ is **self-calibrated** by galaxy-galaxy lensing signals of **three SDSS lens samples** (Oguri & Takada 2011).

In this analysis, the self-calibration is based on **spec-z SDSS lenses**. For cosmic shear analyses of Li+ and Dalal+, the self-calibration is based on low-z photometric HSC galaxies.

Validation of model and analysis choices with mocks



Uncertainties in data

<u>Galaxy-halo connection</u>

- ✳ Galaxy distribution within a DM halo
- ✳ Baryonic effect
- ✳ Assembly bias
- ✳ Incompleteness (observational)

<u>Cosmic shear</u>

- ✳ Baryonic feedback

<u>Observational uncertainties</u>

- ✳ Photo-z bias
- ✳ PSF systematics

Mock Signals

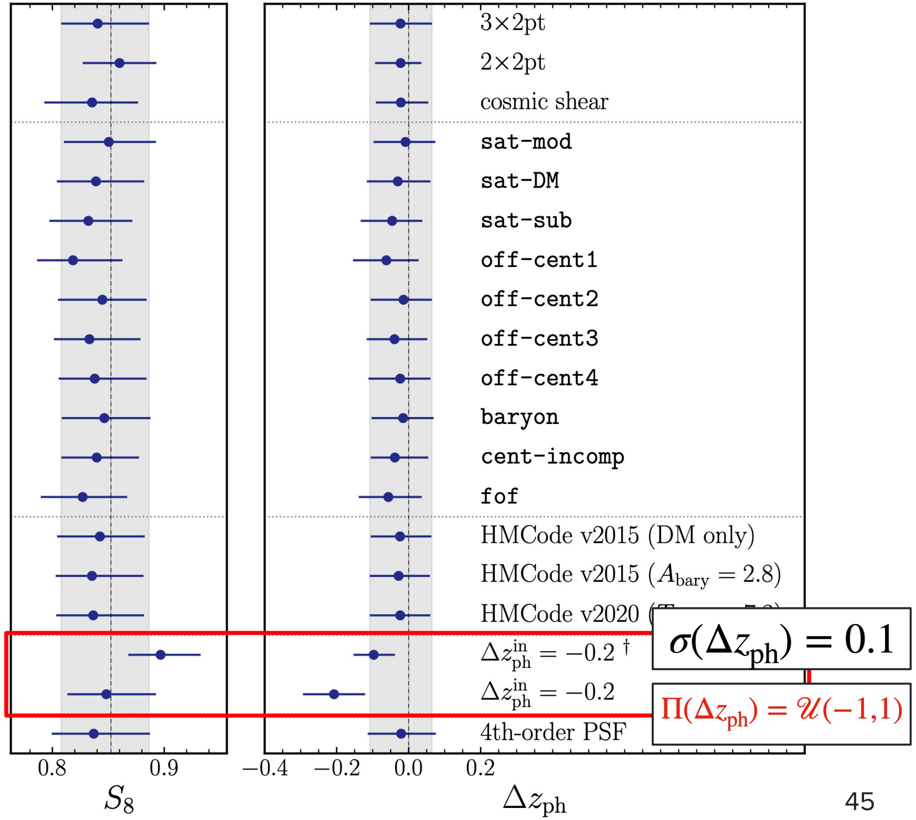
Model fit

- HSC-Y3 covariance
- Analysis setup
  - Scale cut
  - Model
  - Priors

Input Cosmological Parameters

Output Cosmological Parameters

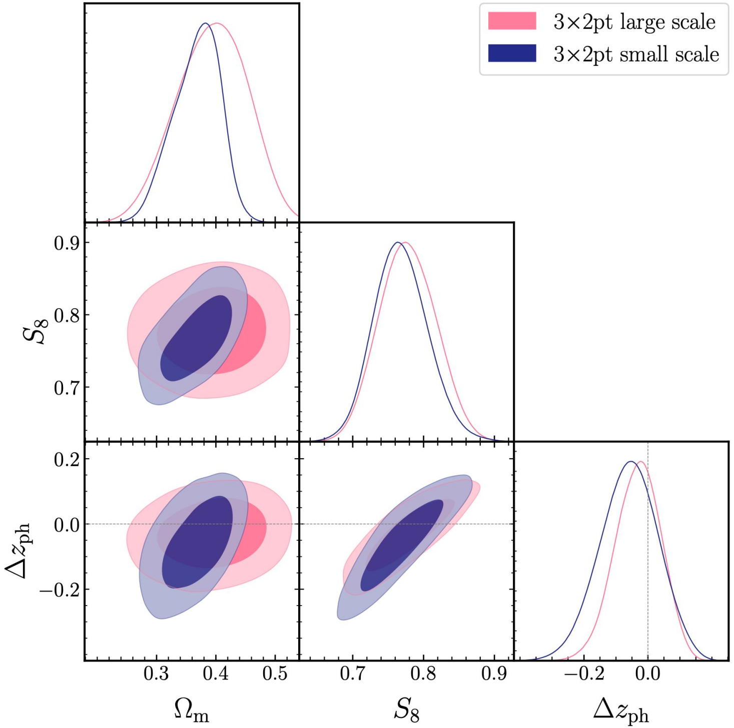
Comparison



$\sigma(\Delta z_{\rm ph}) = 0.1$

$\Pi(\Delta z_{\rm ph}) = \mathcal{U}(-1,1)$

Cosmology from HSC x SDSS 3x2pt analyses



Small-scale analysis result for flat ΛCDM

$$\Omega_{\rm m} = 0.382^{+0.031}_{-0.047}$$

$$\sigma_8 = 0.685^{+0.035}_{-0.026}$$

$$S_8 = 0.763^{+0.040}_{-0.036}$$

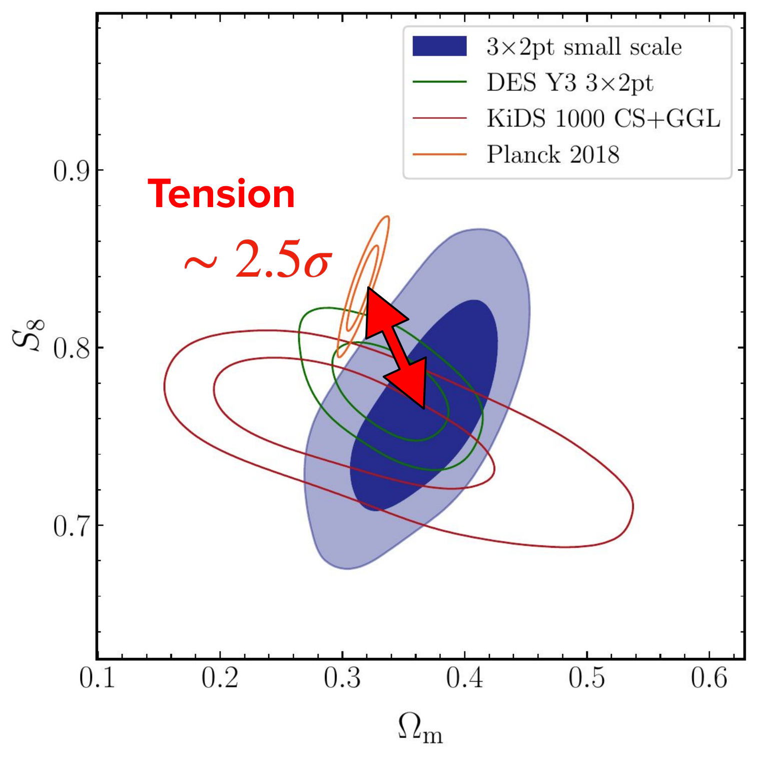
5% constraint!

$$\Delta z_{\rm ph} = -0.05 \pm 0.09$$

- ❑ Good agreement between small & large-scale analysis.
- ❑ Significance of $\Delta z_{\rm ph} < 0$ increases to 1.6σ when we adopt BAO prior on $\Omega_{\rm m}$
- ❑ Small-scale analysis is most sensitive to

$$S_8' \equiv \sigma_8(\Omega_{\rm m}/0.3)^{0.22} = 0.721 \pm 0.028$$

Cosmology from HSC x SDSS 3x2pt analyses



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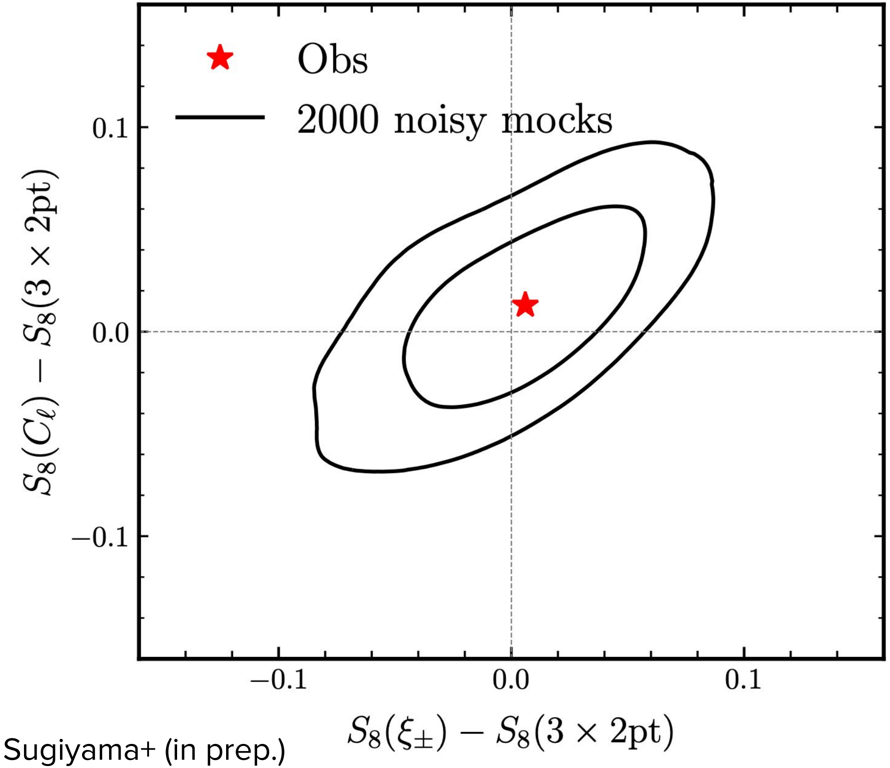
Internal consistency of HSC results



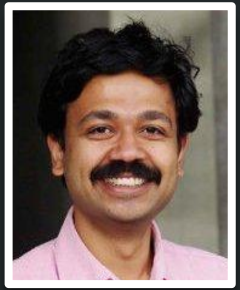
S. Sugiyama+ (in prep.)

We test internal consistency of the results from three HSC projects.

We run simulated analyses on 2000 noisy mocks, taking account of cross-covariance between different projects' probes.

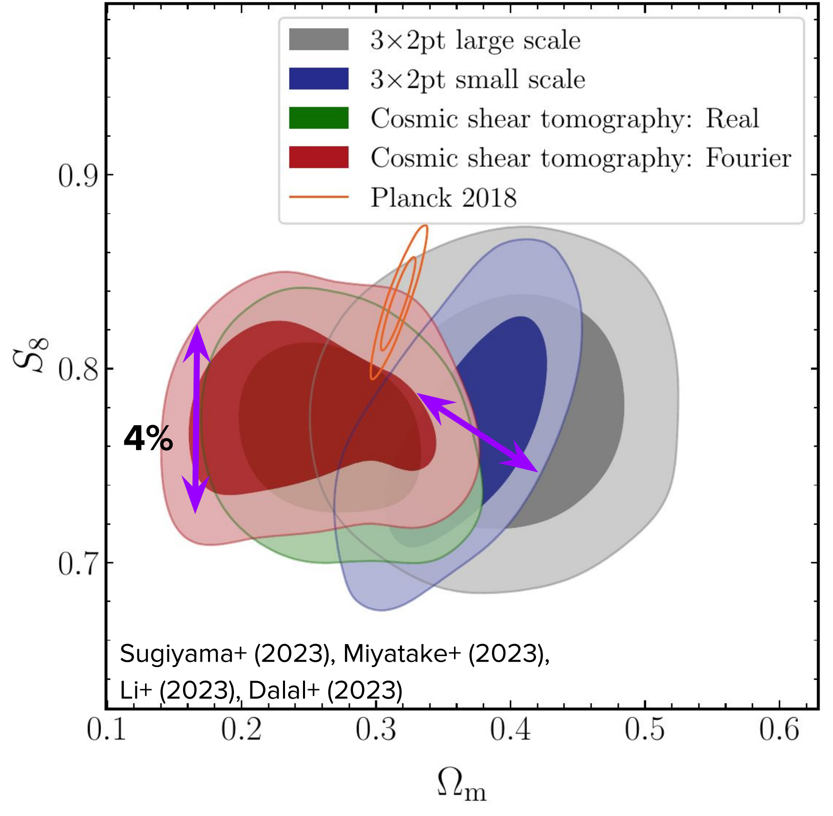
HSC results are fairly consistent with each other!

Summary



Surhud More (IUCAA)

HSC Year 3: Summary of results



Sugiyama+ (2023), Miyatake+ (2023), Li+ (2023), Dalal+ (2023)

- Consistent cosmological constraints from blind analyses
  - Cosmic shear (Real and Fourier space)
  - 3x2 pt analysis (Linear and Quasi-linear scales)
- Conservative analyses in the presence of systematic uncertainties in the redshifts of source galaxies
  - Shear-ratio test currently in progress
- Difference from the CMB expectation in LCDM model context based on various tension metrics range from 2-2.5 sigma

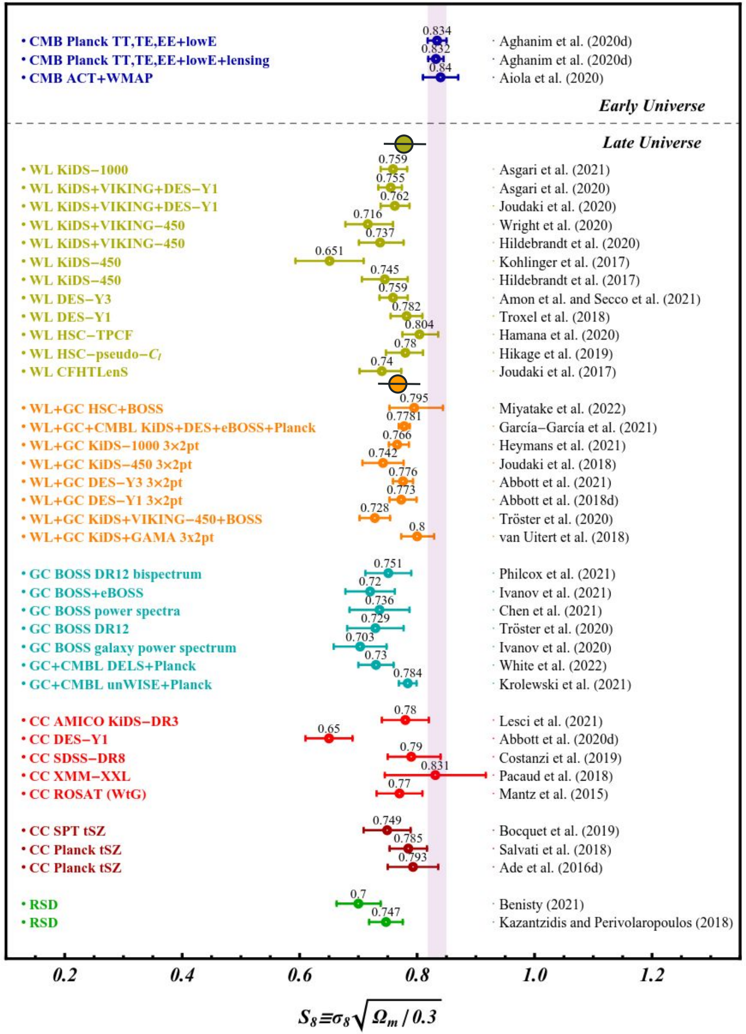
HSC-Y3 Cosmic shear analyses:

Dalal et al. (2023)
Li et al. (2023)

HSC-Y3 3x2 pt analyses:

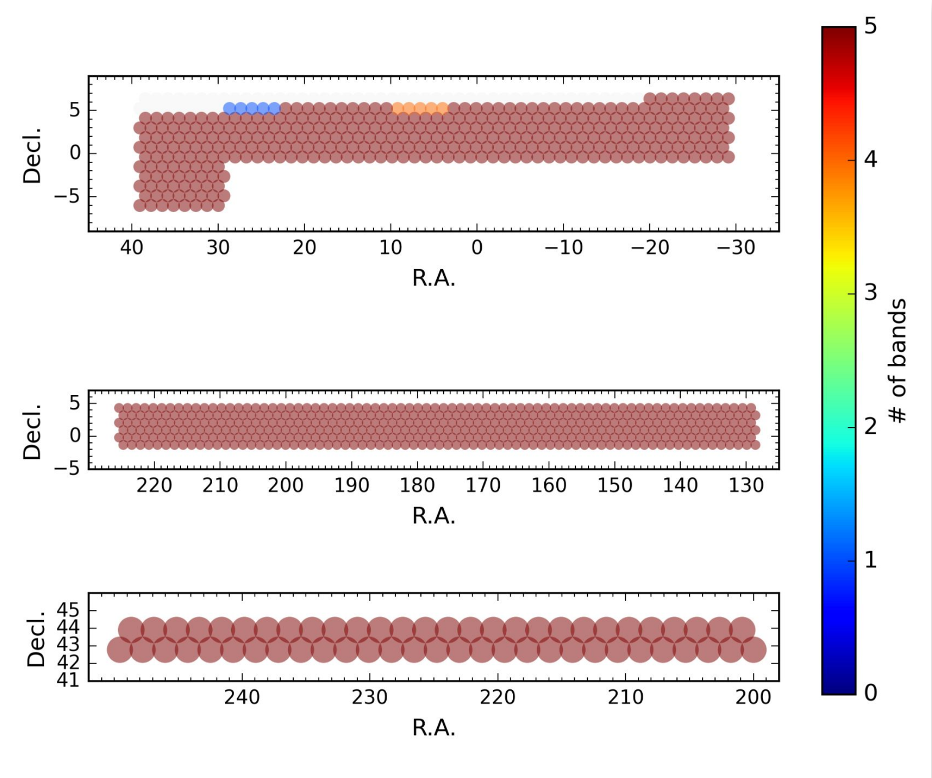
More et al. (2023),
Miyatake et al. (2023)
Sugiyama et al. (2023)

SNOWMASS 2021 Summer study:
Abdalla et al. (2022)



Are we reaching the limits of the standard cosmological model?

HSC survey: the future



Credit: The HSC collaboration team

- Completed HSC survey has a full-depth full-color coverage of about 1087 deg^2
- Data currently being processed at NAOJ using the latest Rubin science pipelines
- Systematics challenges need to be overcome to leverage the statistical power
    - Blending of galaxies, PSF systematics, Source redshift uncertainties amongst others

Key weak lensing group publications: HSC Year 3

- The three-year shear catalog of the Subaru Hyper Suprime-Cam SSP Survey (**Li X.**, et al. 2022, PASJ, 74, 2)
- A General Framework for Removing Point Spread Function Additive Systematics in Cosmological Weak Lensing Analysis (**Zhang T.** et al. 2022, MNRAS submitted, arXiv:2212.03257)
- Weak Lensing Tomographic Redshift Distribution Inference for the Hyper Suprime-Cam Subaru Strategic Program three-year shape catalogue (**Rau, M.** et al. 2022, MNRAS, submitted, arXiv:2211.16516)
- Hyper Suprime-Cam Year 3 Results: Cosmology from Cosmic Shear Two-Point Correlation Functions (**Li X.,** et al. 2023, PRD, to be submitted)
- Hyper Suprime-Cam Year 3 Results: Cosmology from Cosmic Shear Power Spectra (**Dalal R.,** et al. 2023, PRD, to be submitted)
- Hyper Suprime-Cam Year 3 Results: Measurements of the Clustering of SDSS-BOSS galaxies, galaxy-galaxy lensing and cosmic shear (More S., et al. 2023, PRD, to be submitted)
- Hyper Suprime-Cam Year 3 Results: Cosmology from Galaxy Clustering and Weak Lensing with HSC and SDSS using the Minimal Bias Model (**Sugiyama S.,** et al. 2023, PRD, to be submitted)
- Hyper Suprime-Cam Year 3 Results: Cosmology from Galaxy Clustering and Weak Lensing with HSC and SDSS using the Emulator Based Halo Model (Miyatake H., et al. 2023, PRD, to be submitted)

https://hsc-release.mtk.nao.ac.jp/doc/index.php/wly3/

HSC WL data products will be available at same URL after papers are accepted

Question/Answer and Discussion session

Moderator: **Rachel Mandelbaum** (Carnegie Mellon University)

https://hsc-release.mtk.nao.ac.jp/doc/index.php/wly3/