Current Status of Cosmology Analysis with Weak Lensing and Clustering using HSC-Y3 and BOSS

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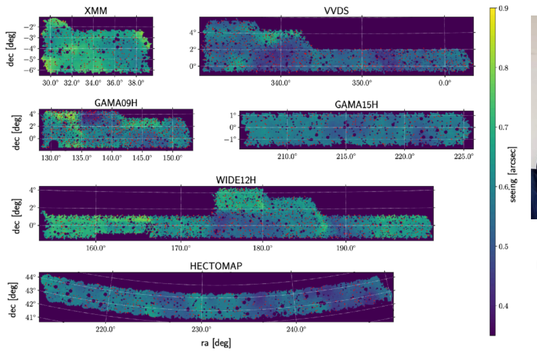
on behalf of HSC Weak Lensing Working Group

HSC-Y3 Cosmology Analyses Are Ongoing

HSC-Y3 Shear Catalog

Survey area is increased to 433 deg² from 137 deg²



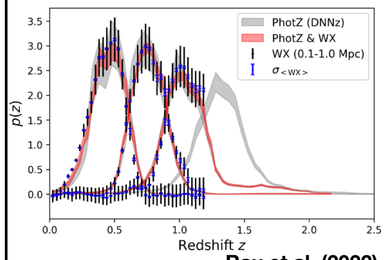
X. Li
(IPMU→CMU)

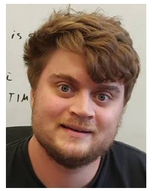
Li et al. (2022)

Detailed Systematics Studies

Photo-z Systematics

Tested photo-z against clustering-z and derived combined inference



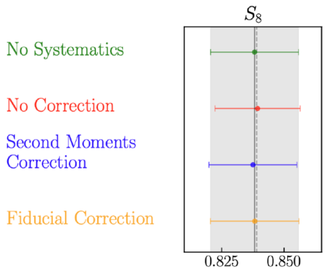


M. Rau (Argonne)

Rau et al. (2022)

PSF Systematics

Investigated how 4th order moments of PSF affect cosmological constraint



T. Zhang (CMU)

Zhang et al. (2022)

Cosmology Analyses

3x2pt (2x2pt + Cosmic Shear) Analyses

Measurement
(S. More; IUCAA)

Large-scale Analysis
(S. Sugiyama; IPMU)

Small-scale Analysis
(H. Miyatake; Nagoya)

Cosmic Shear Analyses

Real-Space Analysis
(X. Li; CMU)

Fourier-Space Analysis
(R. Dalal; Princeton)

- 4 cosmology papers (+1 measurement paper) will be out in April
- Grad. students and postdocs are leading most of the projects.

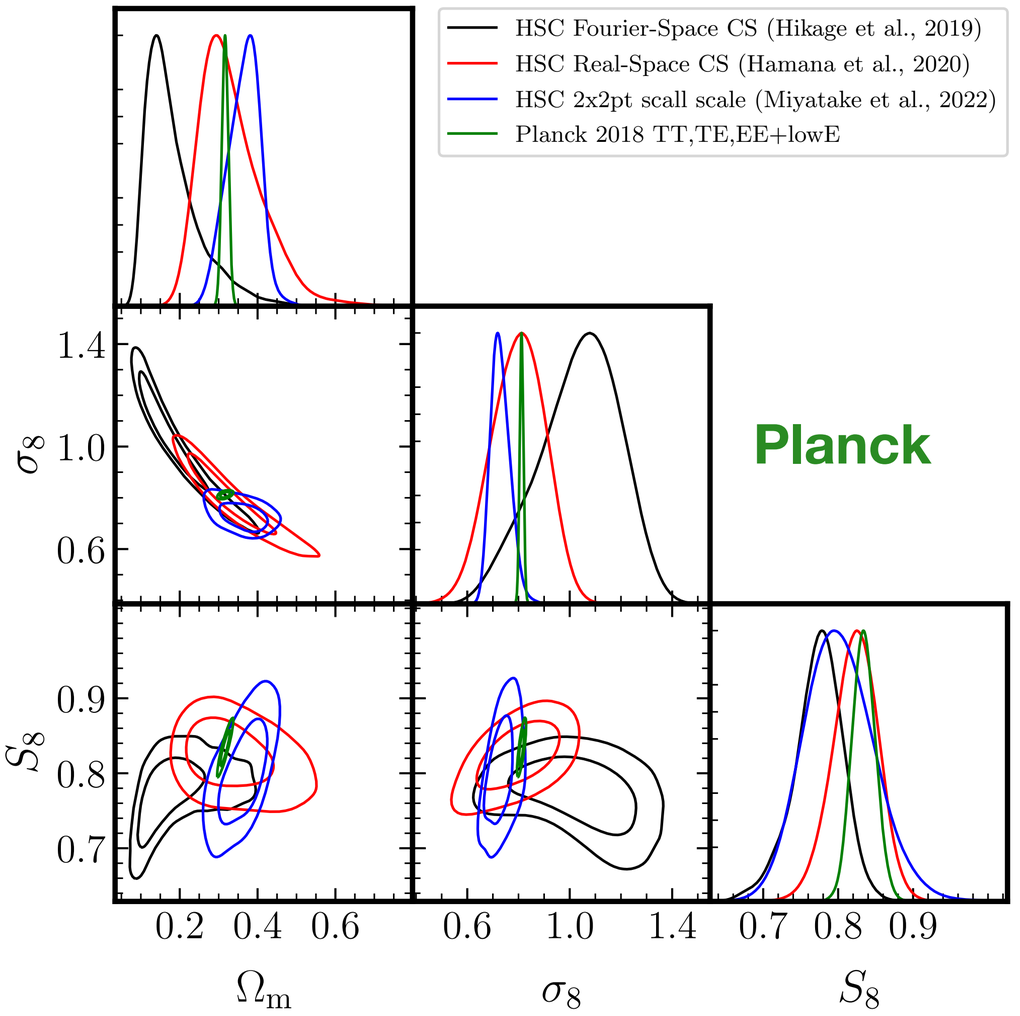
HSC-Y1 Results

$\Omega_{\rm m}$: Matter energy density

σ_8: Amplitude of matter power spectrum
(or clumpiness of the Universe)

$$S_8 \equiv \sigma_8 \sqrt{\Omega_{\rm m}/0.3}$$

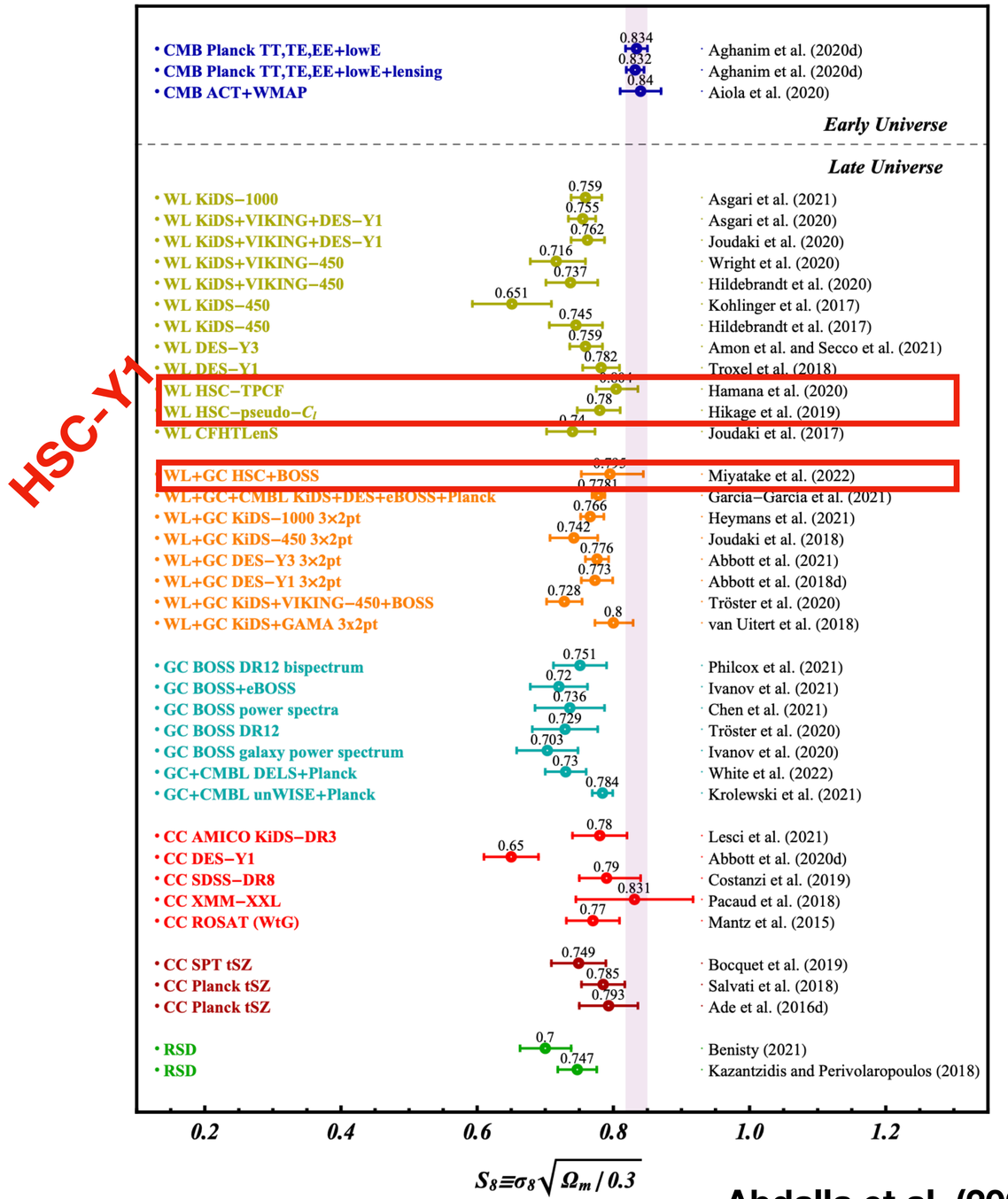
S_8 measured by HSC, i.e., from large-scale structure, is smaller than S_8 from CMB?



S_8 Tension

Late universe (z<~1) probes (weak lensing, galaxy clustering, cluster count, RSD) consistently yield S_8 smaller than an early universe probe (CMB).

Smoking gun of
the breakdown of ΛCDM?



Abdalla et al. (2022)

3x2pt Cosmology Analysis

- Weak lensing enables us to measure the distribution of dark matter (~80% of the matter in the Universe)

3x2pt

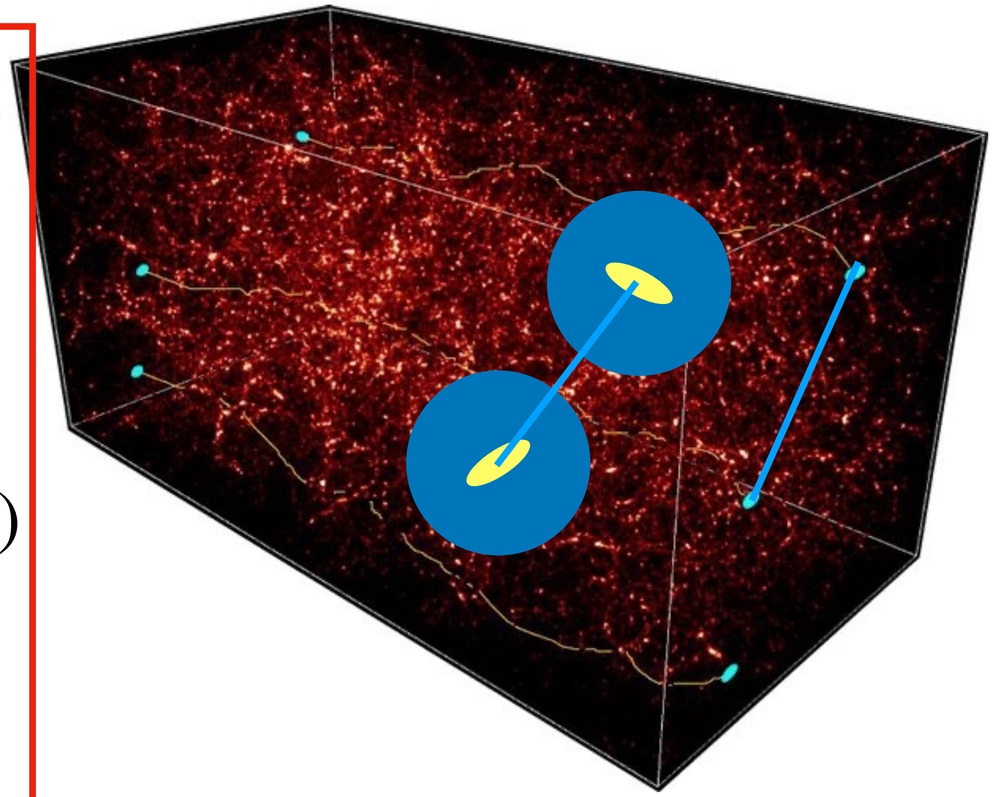
- Cosmic shear
  - auto-correlation of weak lensing shear
    $\langle \gamma\gamma \rangle \sim \xi_{\rm mm}(\Omega_{\rm m}, \sigma_8)$

- 2x2pt

Galaxy bias

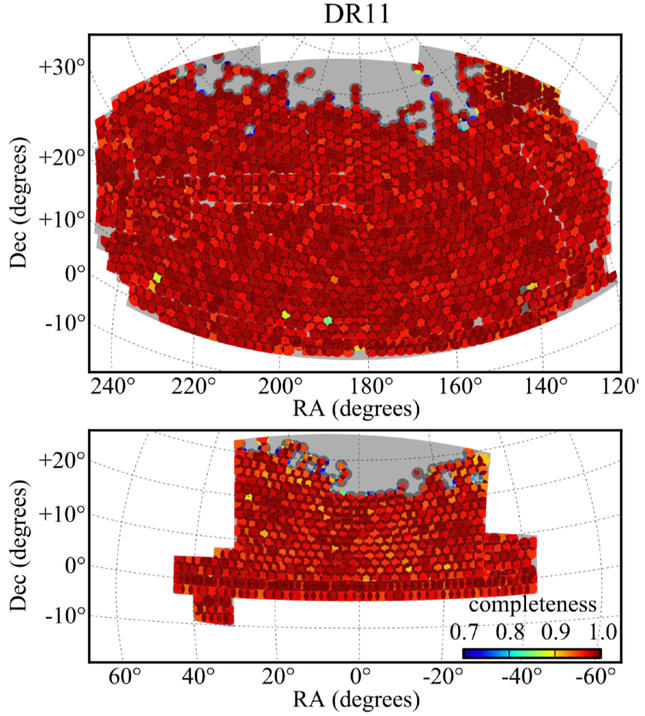
  - Galaxy-galaxy clustering $\langle gg \rangle \sim b^2 \xi_{\rm mm}(\Omega_{\rm m}, \sigma_8)$
  - Galaxy-galaxy lensing $\langle g\gamma \rangle \sim b \xi_{\rm mm}(\Omega_{\rm m}, \sigma_8)$

→ Combining $\langle gg \rangle$ and $\langle g\gamma \rangle$ cancels out b and enables us to extract $\xi_{\rm mm}(\Omega_{\rm m}, \sigma_8)$.



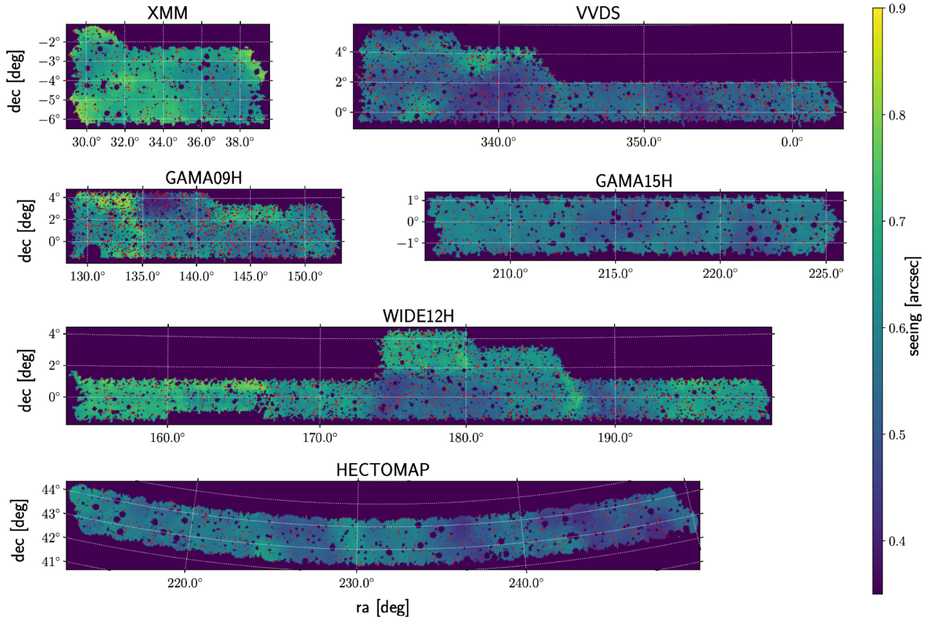
Data

SDSS/BOSS Spec-z sample: ~8300deg²



- **3** redshift samples
  - z = [0.15, 0.35]
  - z = [0.47, 0.55]
  - z = [0.55, 0.70]
- Luminosity cut is applied to obtain volume-limited sample.

HSC-Y3: 433deg²



A **single** source redshift sample at z>0.75

Galaxy-galaxy Clustering

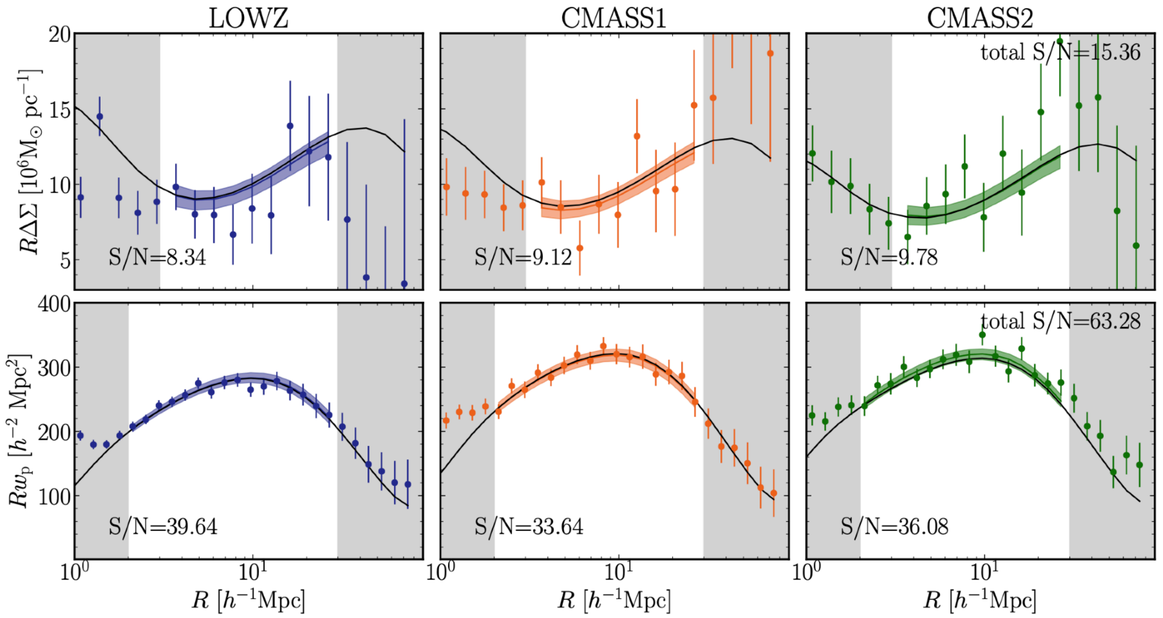
Galaxy-galaxy Lensing

Cosmic Shear

Measurements

HSC-Y1 Analysis

Galaxy-galaxy Lensing



Galaxy-galaxy Clustering

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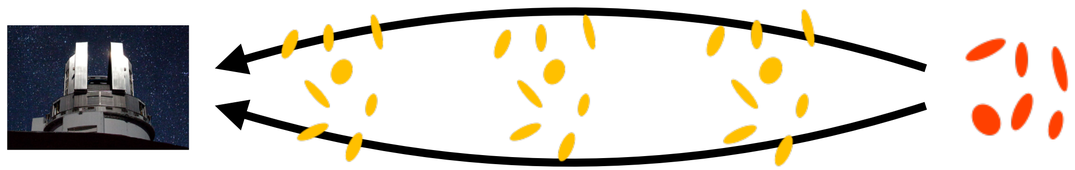
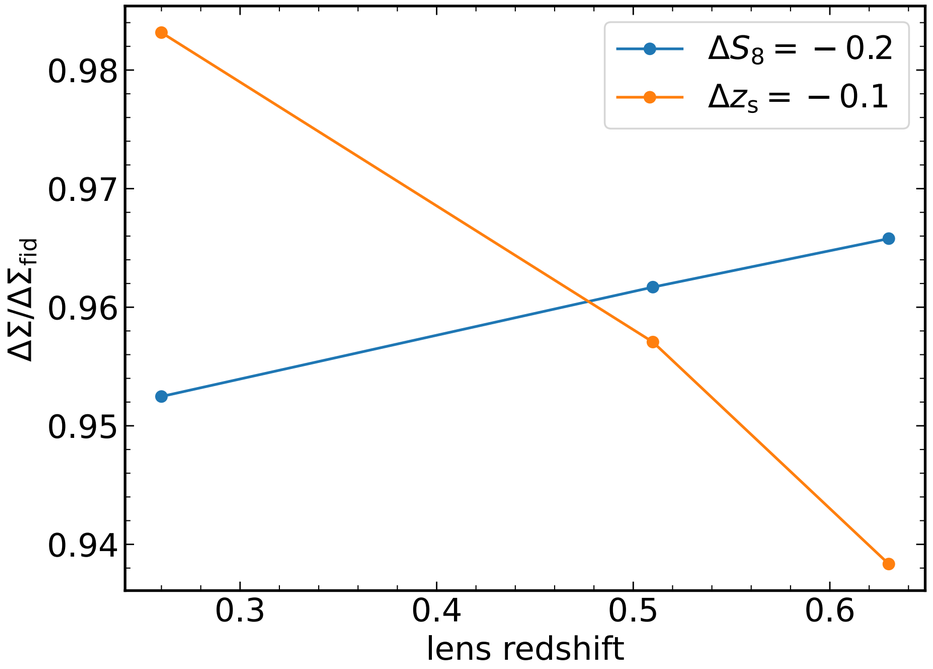
Photo-z Redshift Calibration

$$\gamma \propto \frac{D_A(z_l, z_s) D_A(z_l)}{D_A(z_s)} \delta(z_l)$$

Our configuration

- **3 lens samples**
- **1 source sample**





Lensing signal has a difference response for ΔS_8 and Δz_s.

Δz_s can be calibrated if we have multiple lens samples for a single source sample!

Oguri & Takada (2011)

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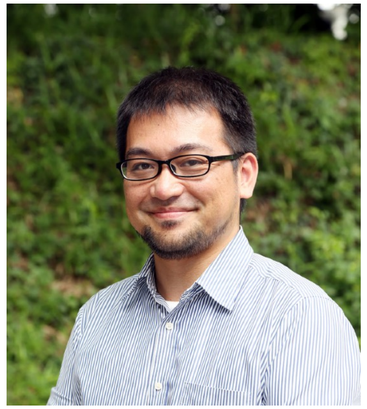
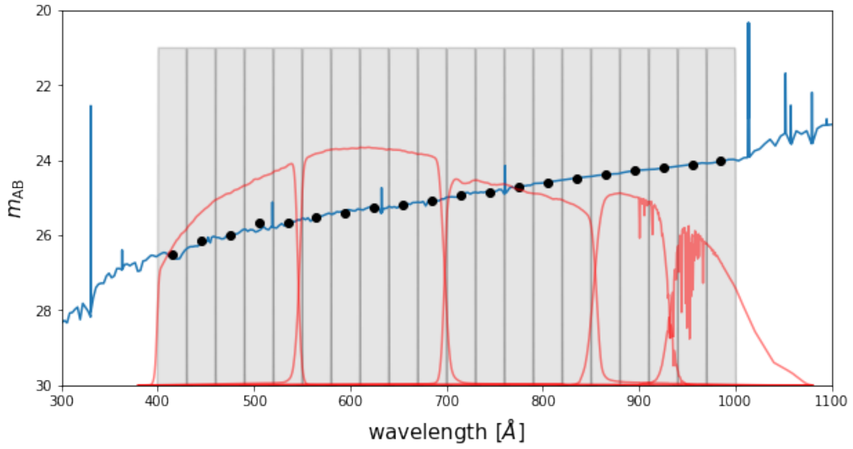
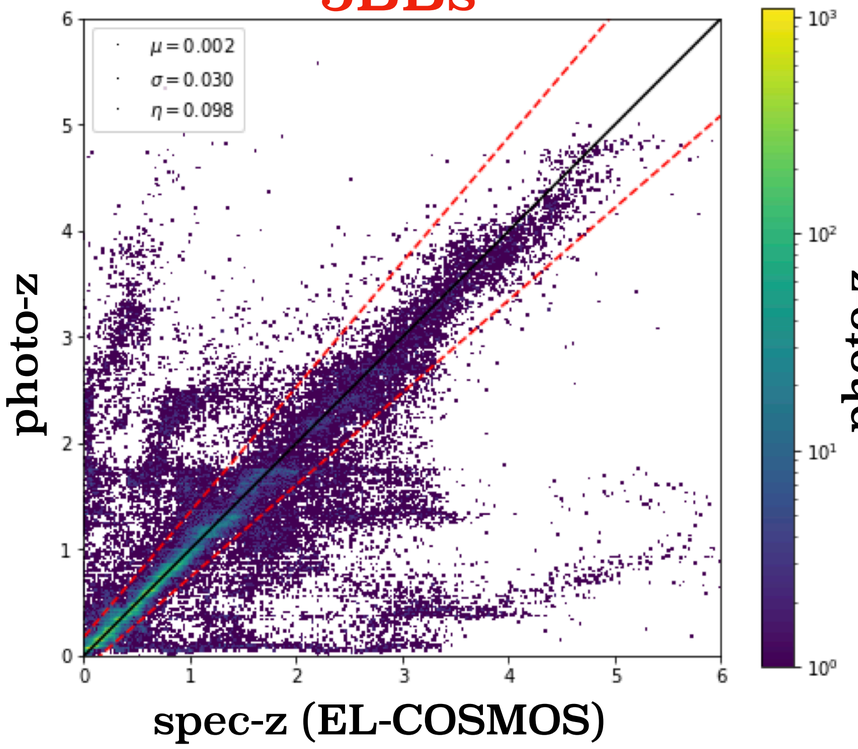
HSC-MB Filters



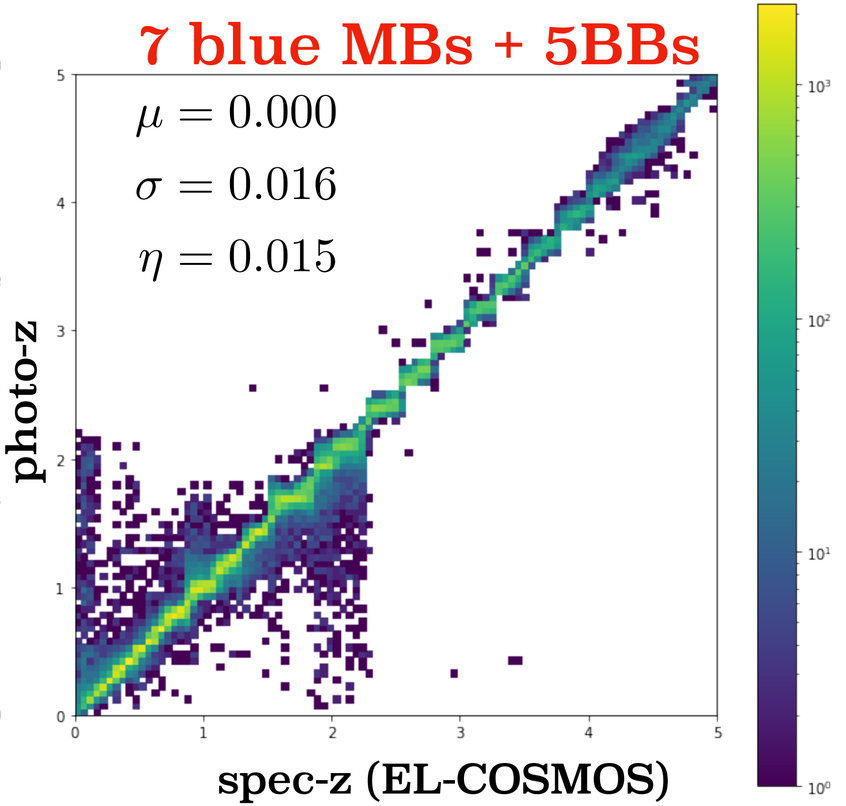
A. J. Nishizawa



5BBs



7 blue MBs + 5BBs



- Medium-band filters will be installed in HSC (using budget from 国際先導研究).
- They can improve photo-z calibration of faint, high-z galaxies (PFS will be useful, of course!).
- Any good science case with Medium-band filters?

Summary

- HSC Y-3 cosmology analyses are going on.
- 3x2pt results will be out together with cosmic shear analyses in a few months.
- We carry out photo-z self-calibration in the 3x2pt analysis.
- Medium-band filters can improve photo-z calibration of faint, high-z galaxies.