

# 16 HSC Medium Band

**Atsushi J. Nishizawa (Gifu-Shotoku)**

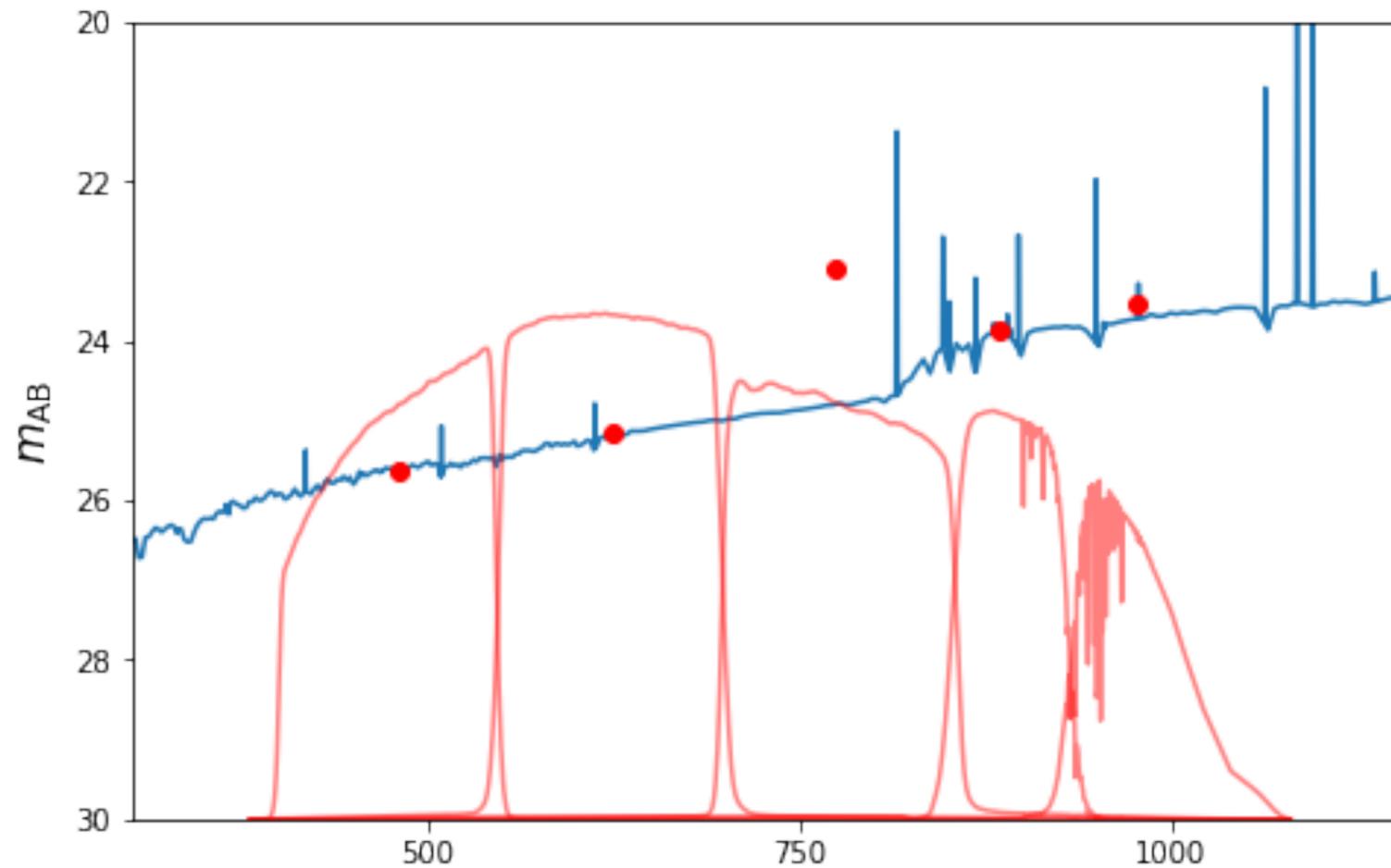
Hironao Miyatake (Nagoya), Tadayuki Kodama (Tohoku), Federica Tarsitano (ETH)

Eiichi Egami (Arizona) and HSC MB collaboration

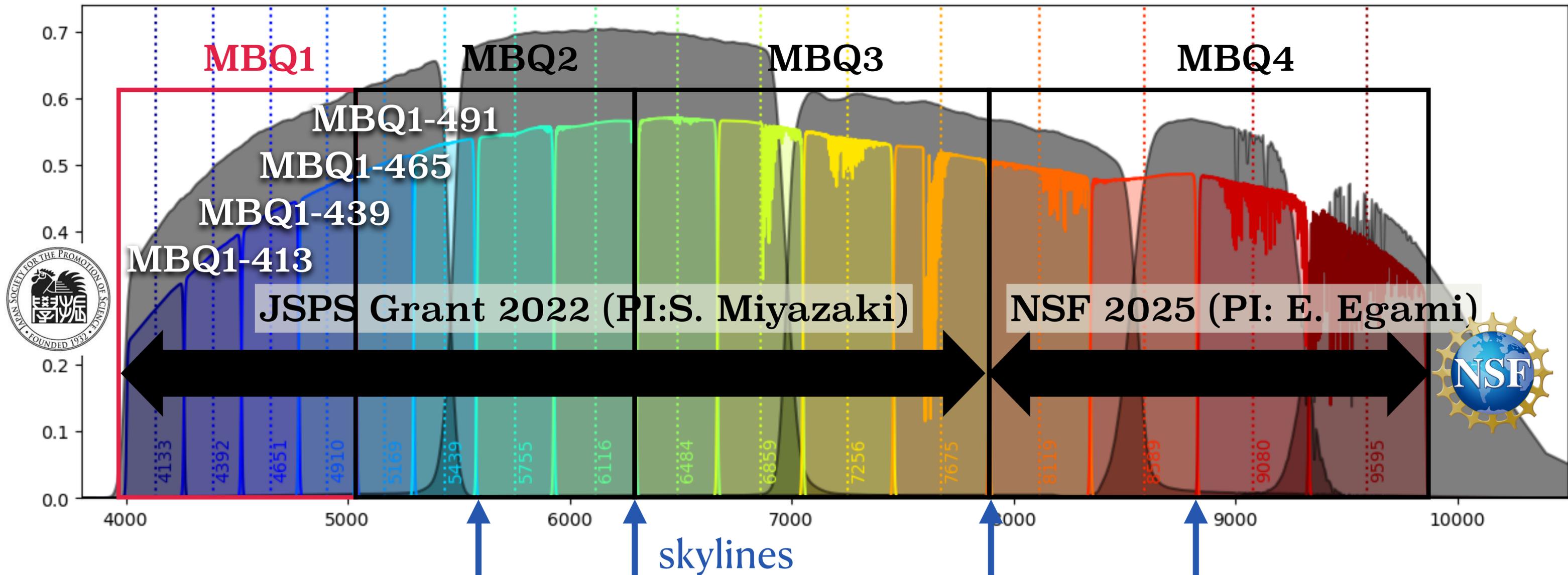
**Subaru User's Meeting @ NAOJ Oct. 29-31, 2025**

# photometric (imaging) observation

- Basically, the imaging survey is to obtain the image of the object
- But another physical information lies in the wavelength direction
- A photometric filter can be a good way to go



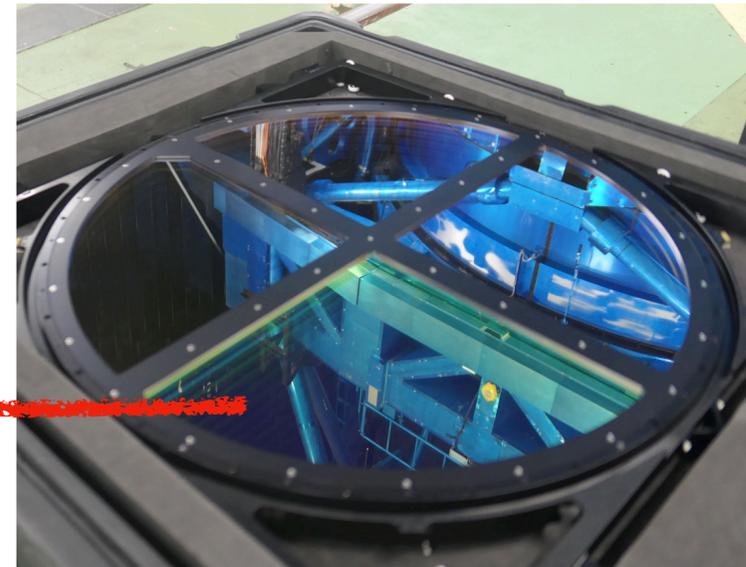
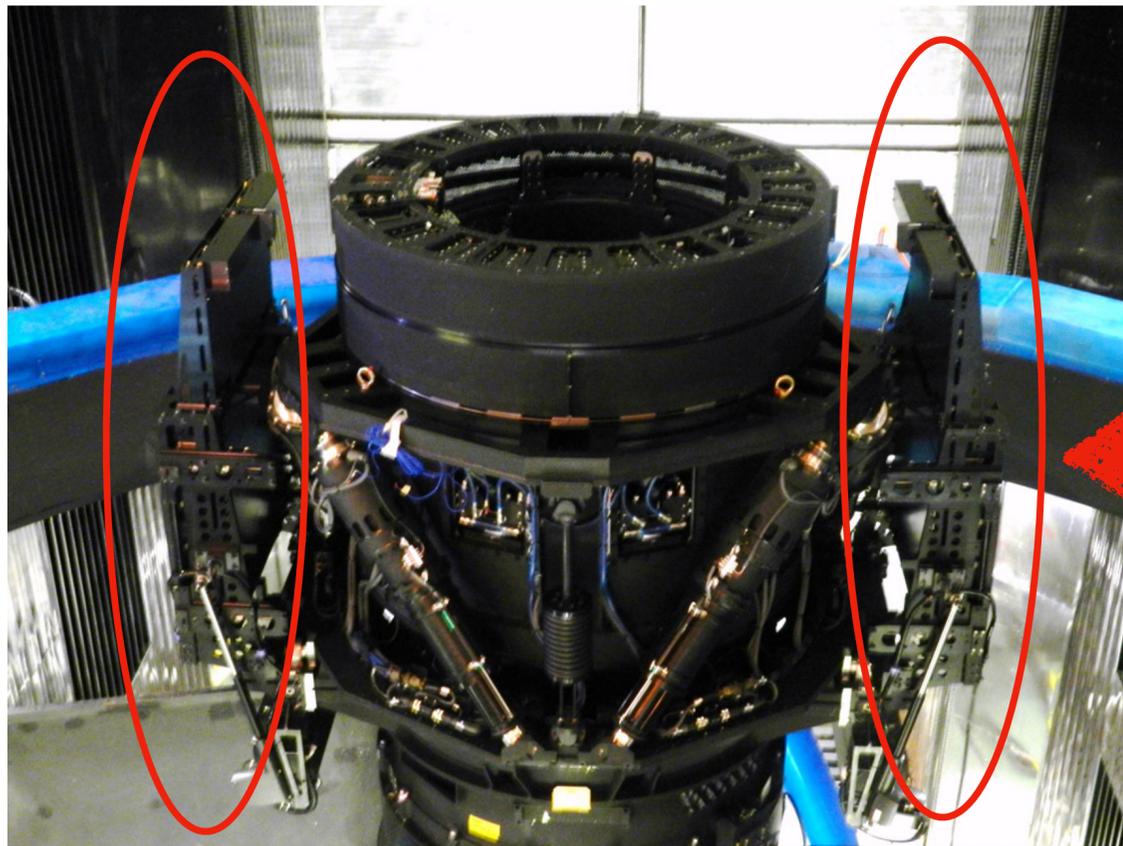
# MB Filter transmission



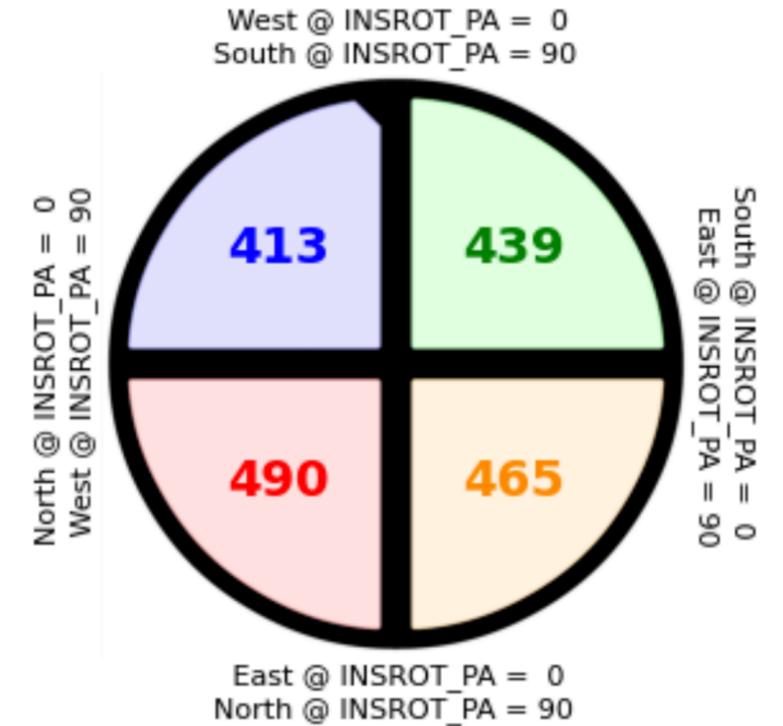
- 4 Blue bands : continuous 4 filters of  $d\lambda=25\text{nm}$  (same as the DECam MB: IBIS)
- 5th to 16th bands : Bluer bands are relatively narrower than redder bands.
- Avoid any of the strong sky emission lines (they drop in the gap of the filters)
- reddest 4 bands (8k-10k Å) are now funded by NSF, thanks to Egami-san!!
- Now, the **MBQ-1** is on Subaru, (please contact [atsushi.nisizawa@gifu.shotoku.ac.jp](mailto:atsushi.nisizawa@gifu.shotoku.ac.jp))

# Filter Fabrication -mechanical design-

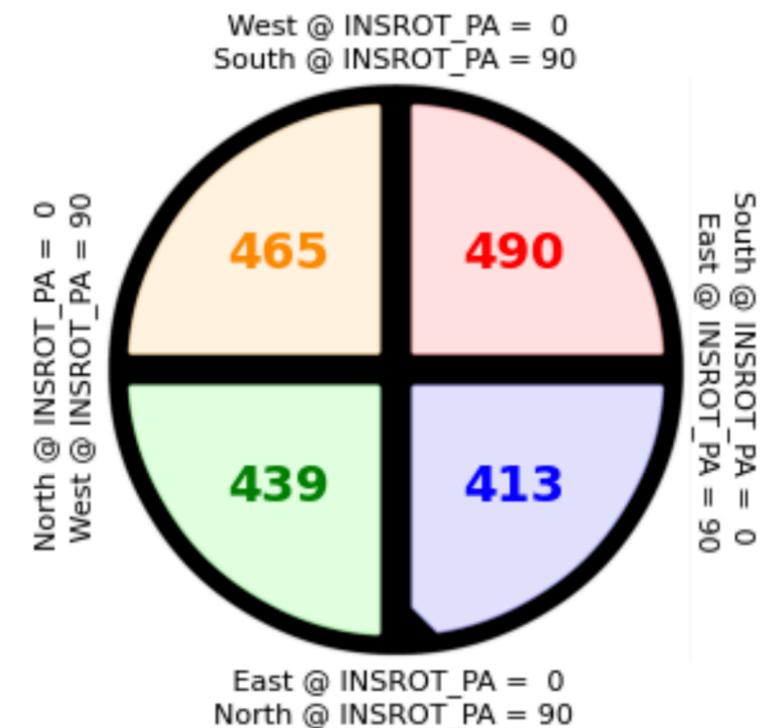
- HSC has a filter exchange unit (FEU) on both sides of the camera
- Each FEU has 3 slots of filters (6 in total)
- During the obs. run (~14 days in gray/dark nights), only 6 filters are available in the FEU.
- it takes 30 min. for filter exchange (among 6, chose 1 filter)
- telescope rotation, 1min./90 deg., CCD readout 30 sec.
- -90 → 0 → 90 → 180



[when inserted from FEU-Opt stacker]



[when inserted from FEU-IR stacker]







Subaru Telescope

Weather

Observing

Schedule

Telescope

Instruments

ETCs

HSC ETC

# HSC Exposure Time Calculator

(version 2.2.8; updated on July 21, 2025)

The evaluation report can be viewed [here](#).

Instrument:

Object:

Brightness:  =  mag (AB)

Point source: Seeing =  arcsec (use circular aperture of a given diameter)

Note: The statistics of seeing measurements can be seen [here](#).

Extended source: Solid angle =  arcsec<sup>2</sup> (use mag per arcsec<sup>2</sup> in "Brightness")

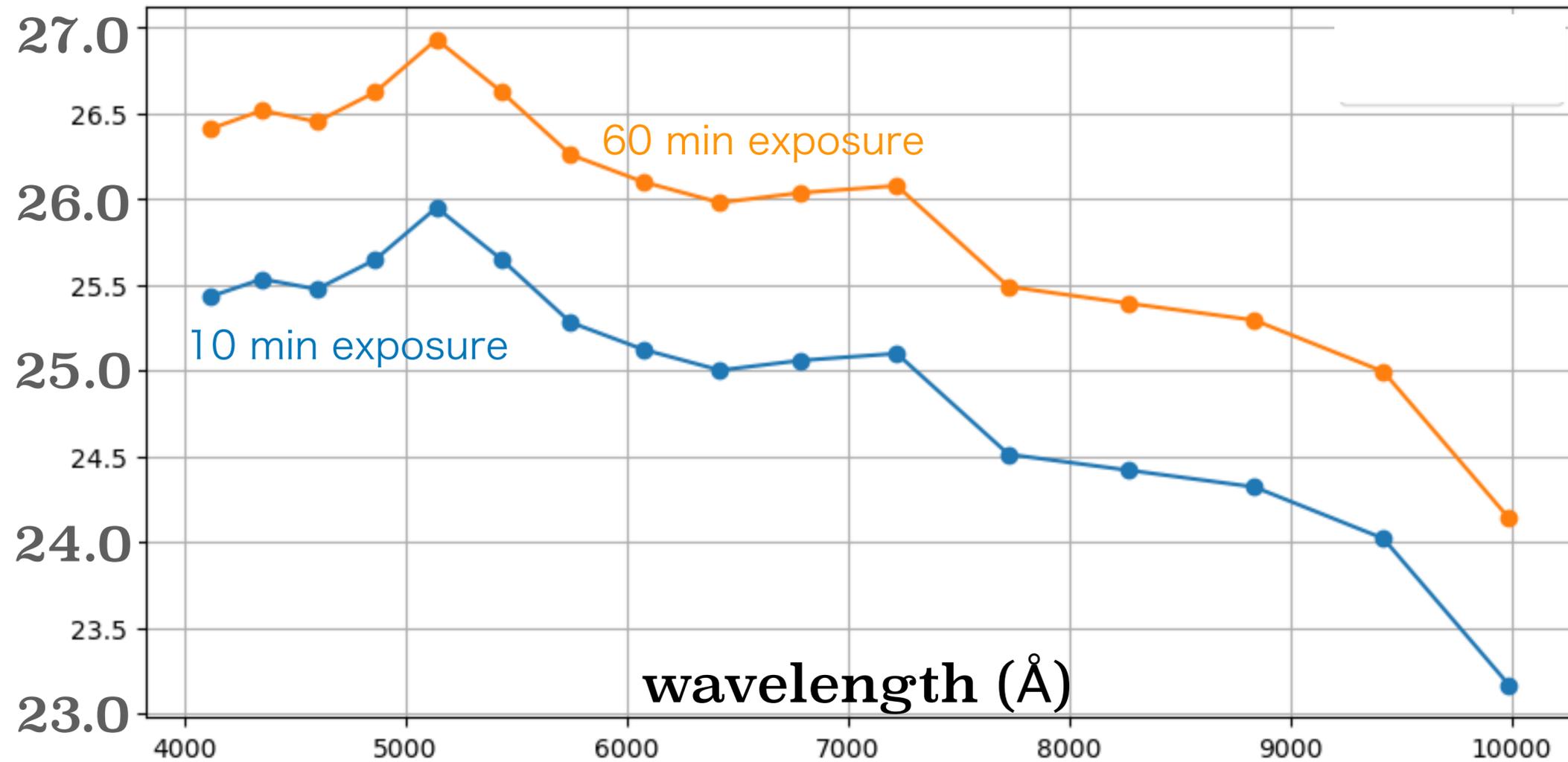
Conditions:

You can find the MBQ1 filter info at Subaru web site

User filters

Filter	Center	Area-weighted mean	Sensitivity <sup>(1)</sup> (AB mag)	mag for 1 e <sup>-</sup> /s	Open <sup>(2)</sup> from	When is it available without permission? <sup>(3)</sup>
MBQ1	<a href="#">Plot</a> <a href="#">Lists</a>	<a href="#">Plot</a> <a href="#">Lists</a>	MBQ1-413: 26.4 <sup>(5)</sup>	MBQ1-413: 26.4	S26A	<b>S27B<sup>(3)</sup></b>
			MBQ1-439: 26.5 <sup>(5)</sup>	MBQ1-439: 26.7		
			MBQ1-465: 26.4 <sup>(5)</sup>	MBQ1-465: 26.7		
			MBQ1-490: 26.4 <sup>(5)</sup>	MBQ1-490: 26.9		

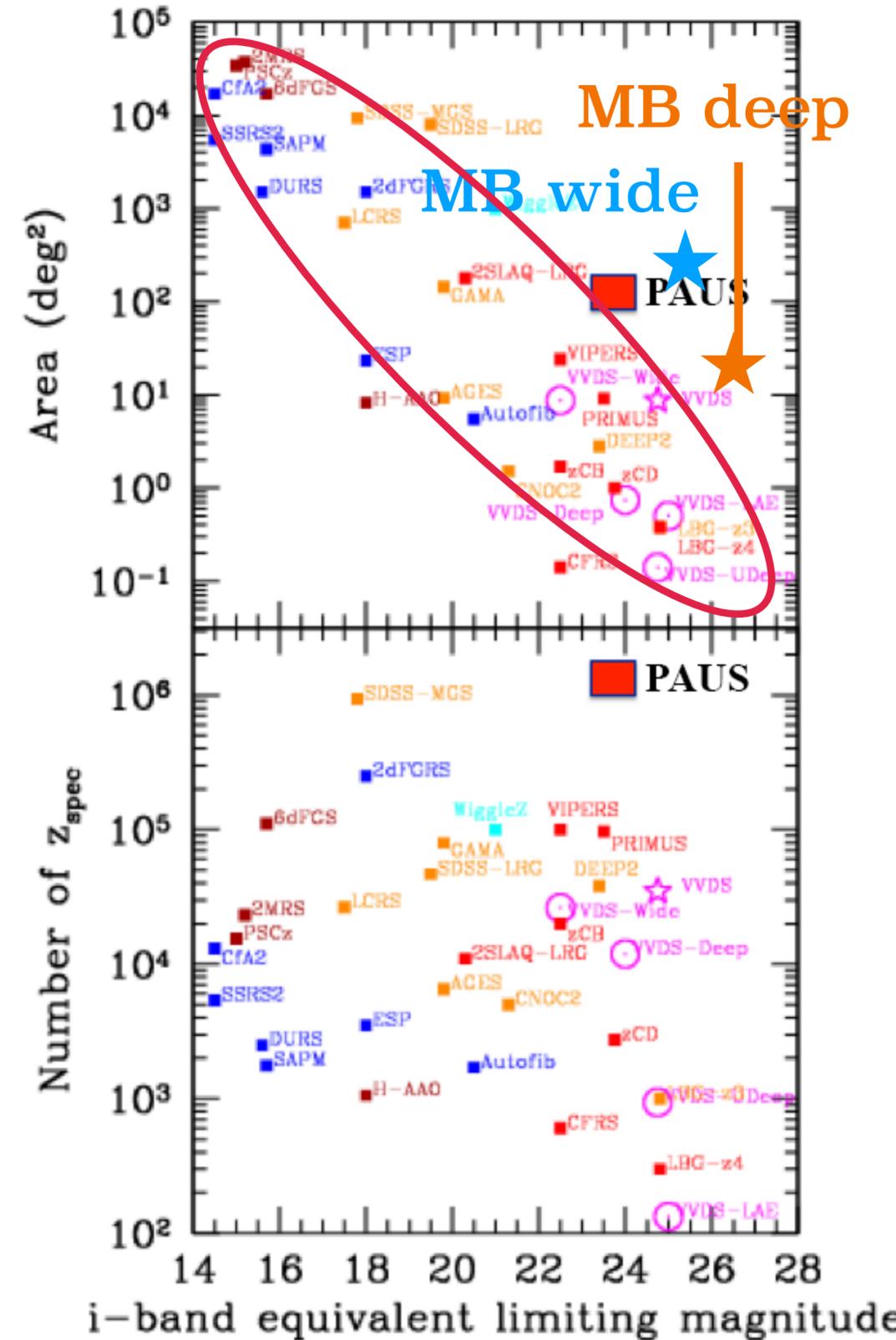
# Subaru MB filters on HSC : Expected Depth



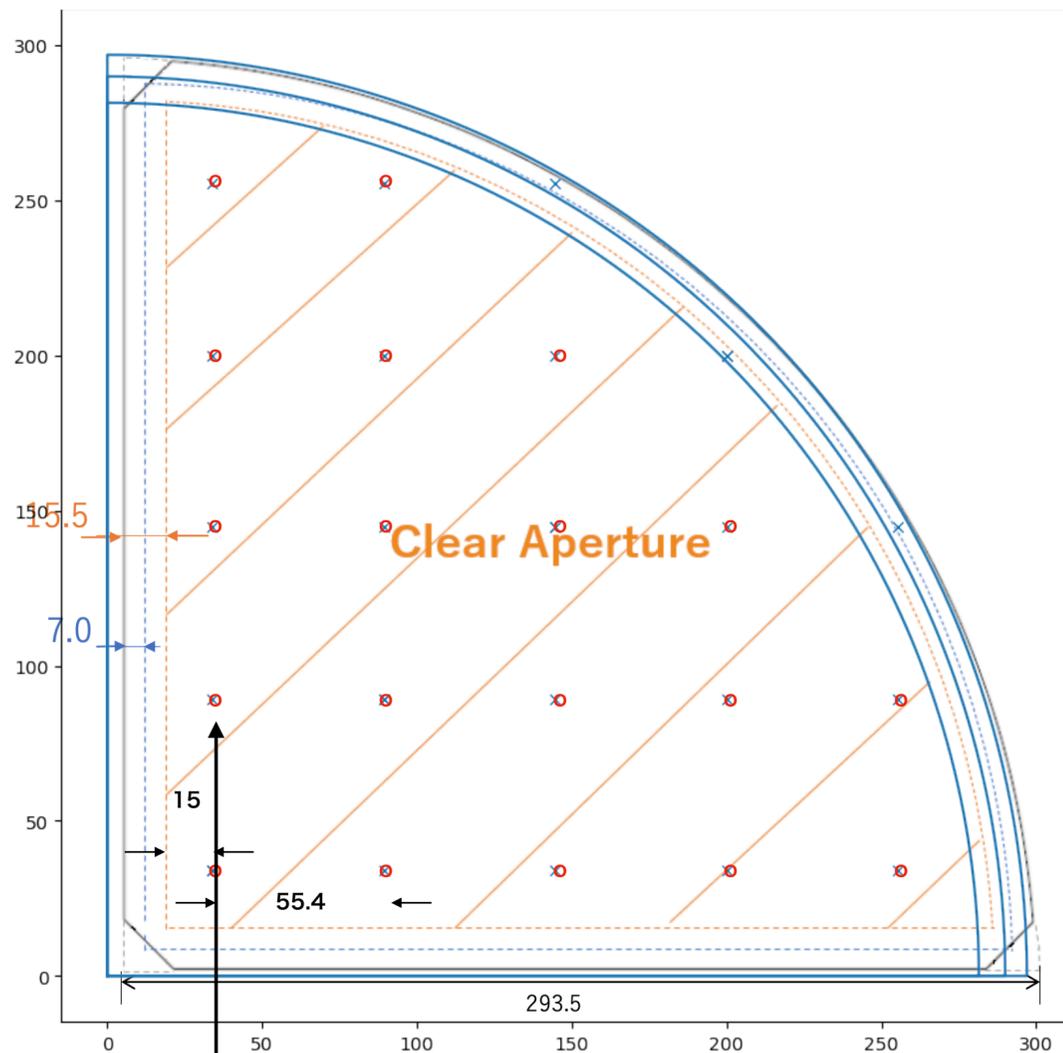
In 40 nights (incl. weather) we can observe either

**Deep: 60 min. exposure**  
 -> 26.5 mag@450nm  
 30 deg<sup>2</sup> with 16 filters

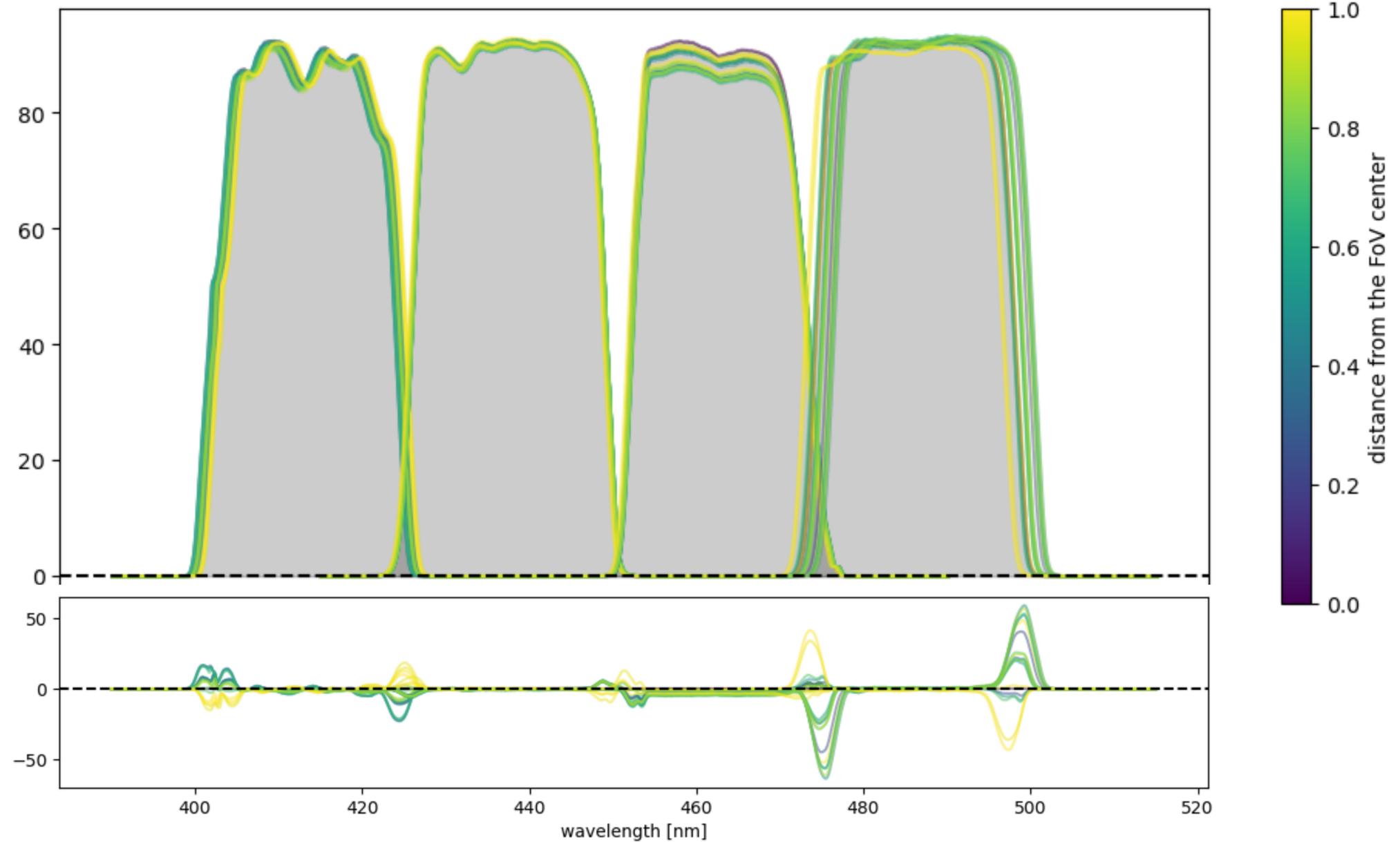
**Wide: 10 min. exposure**  
 -> 25.5 mag@450nm  
 600 deg<sup>2</sup> with 4 filters



# Transmission Quality Assurance

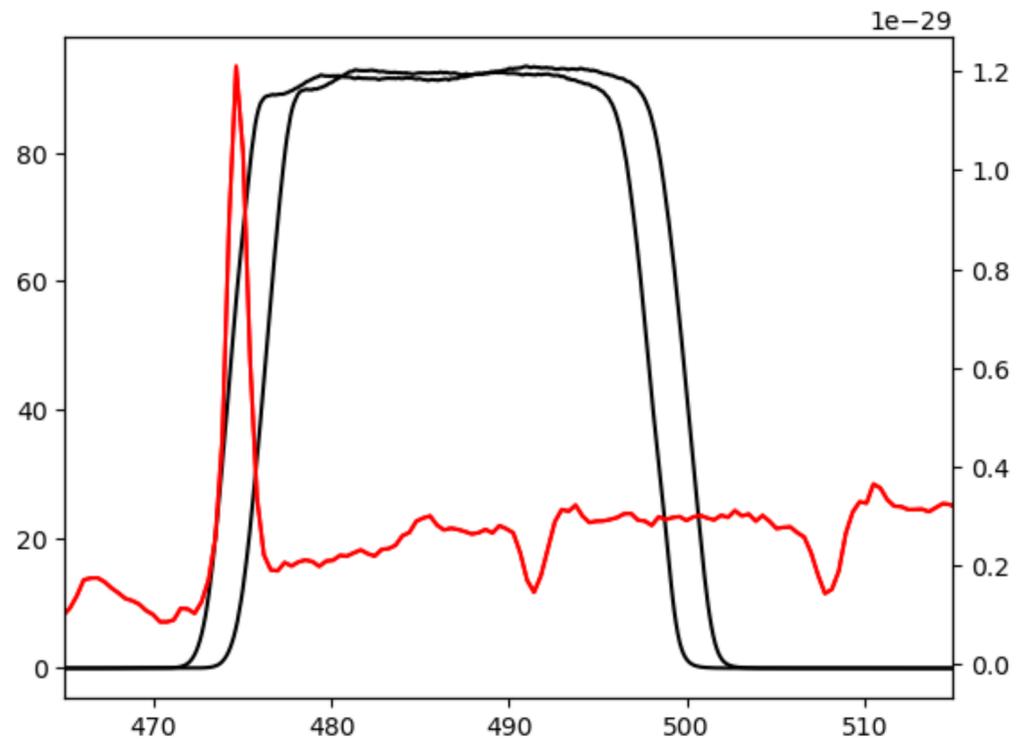


measurement points

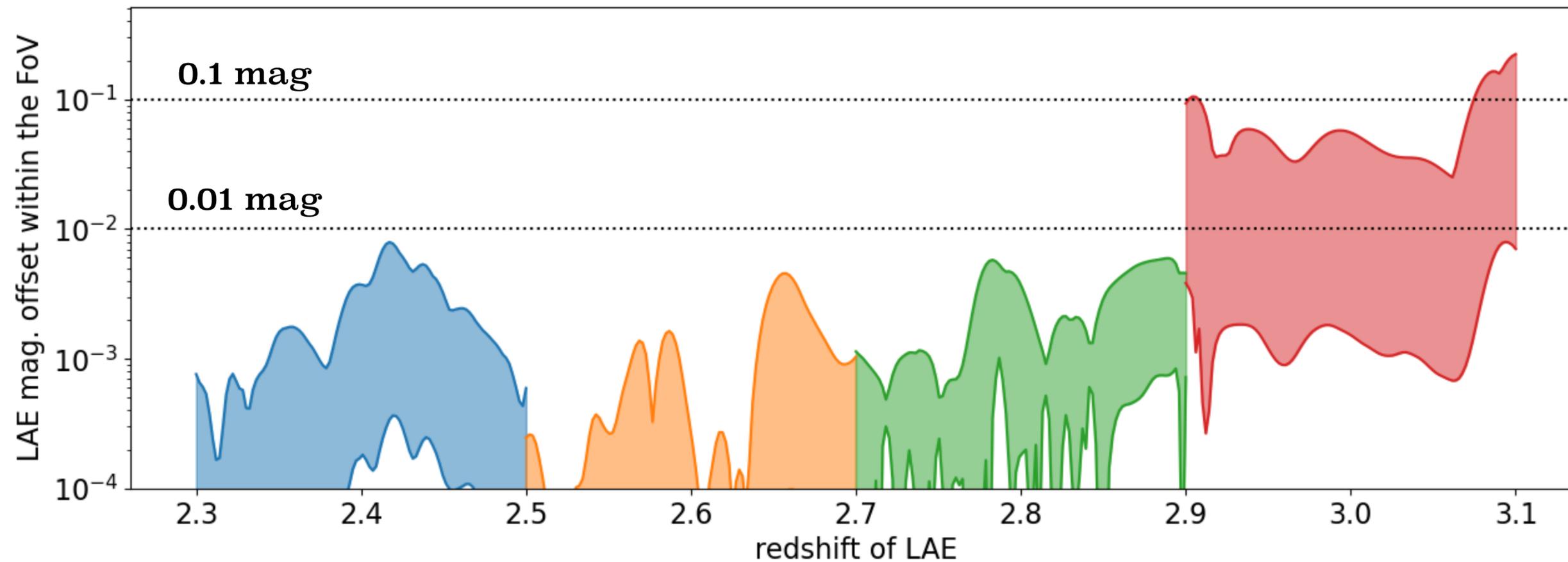


- measure the transmissions at 19 points in FoV
- negligible effect of injection angle of light at the edge of the FoV
- coating inhomogeneity (wavelength shift) is most significant for MBQ1-491

# possible bias in the LAE fluxes



- Assume we observe LAEs in the MB filters at different positions.
- Due to the different transmission curve depending on the position they drop, the observed magnitude (color) should be biased.
- These bias should be calibrated when the LAE is observed multiple times at different position of the FoV.



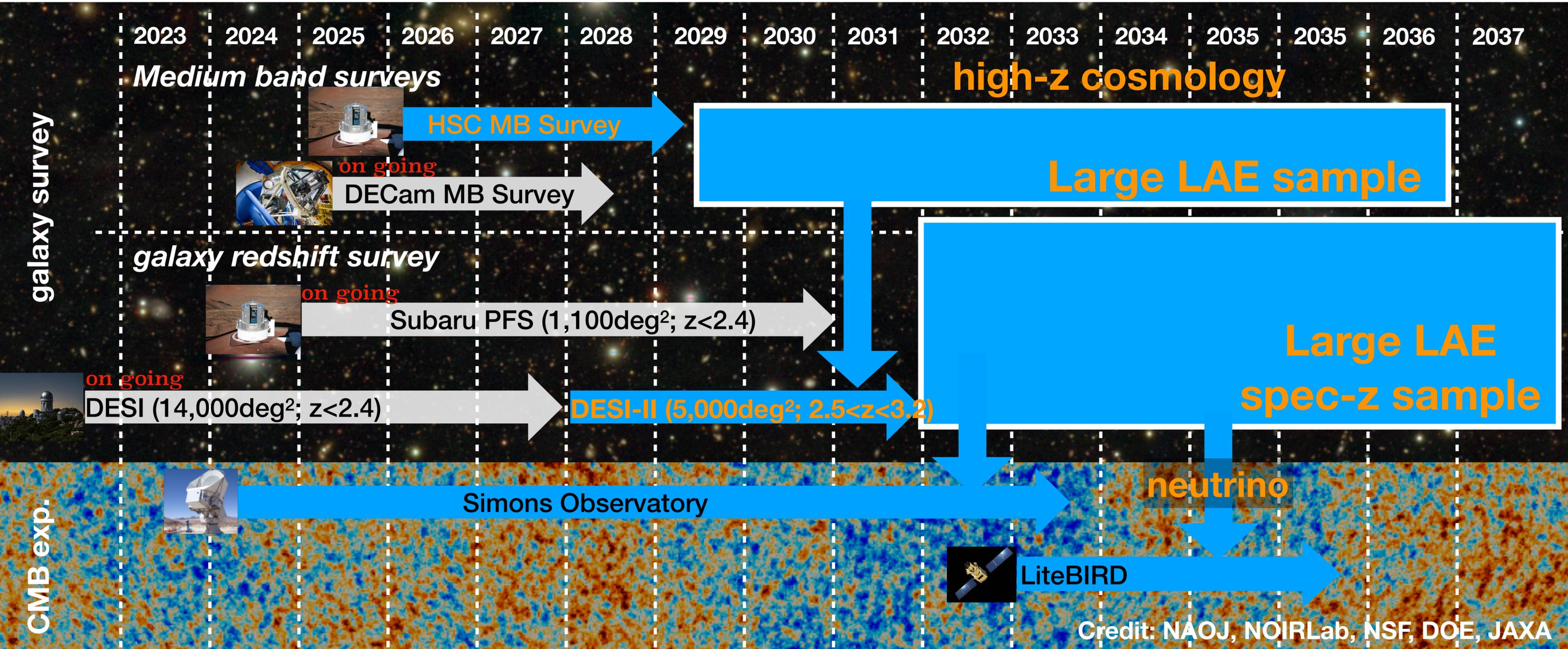
# Synergy with DESI-2

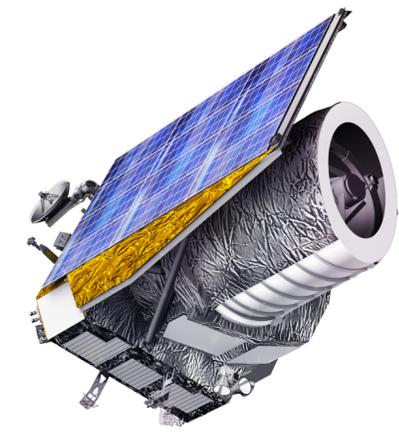


H. Miyatake (Nagoya)



D. Schlegel (LBNL)

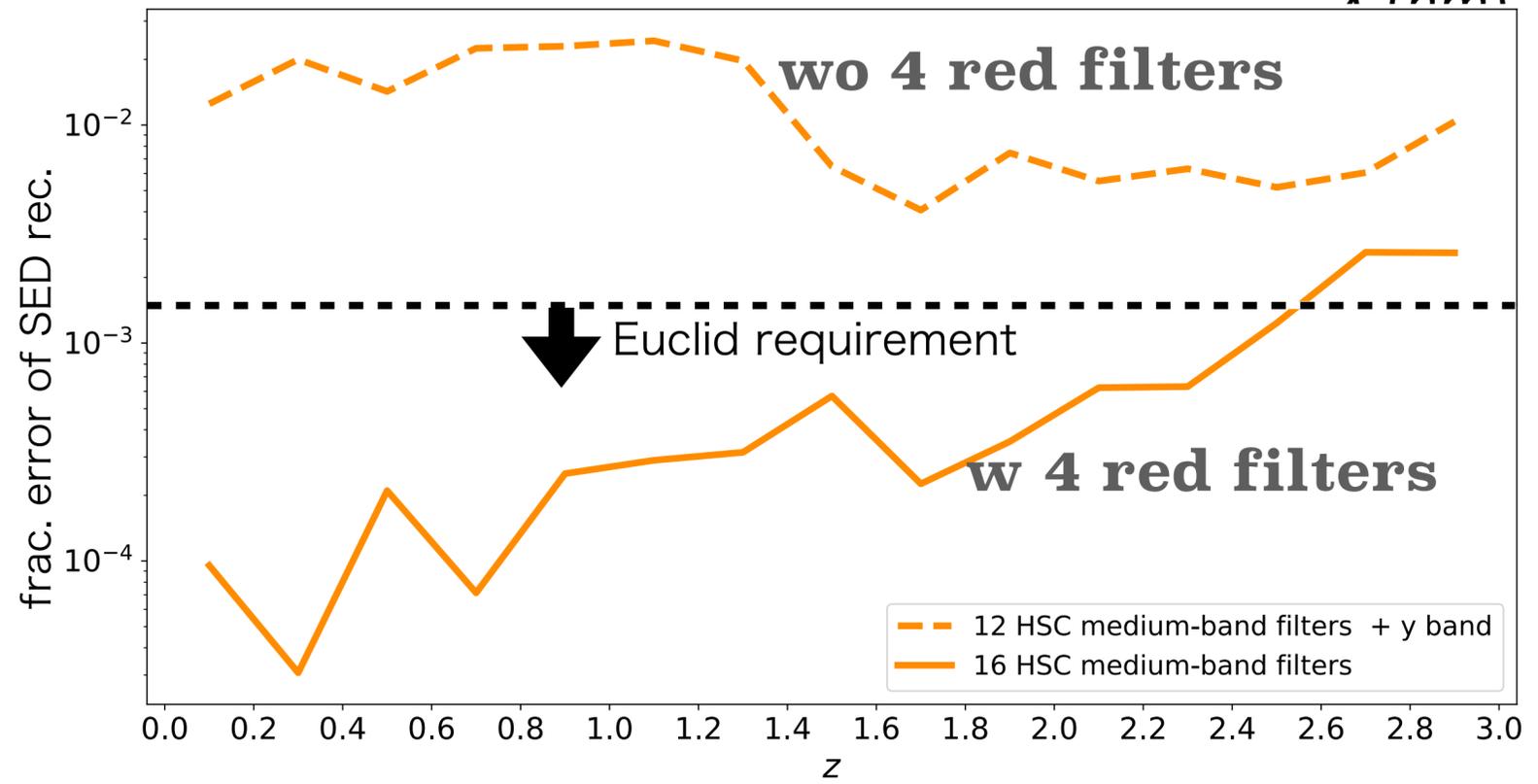
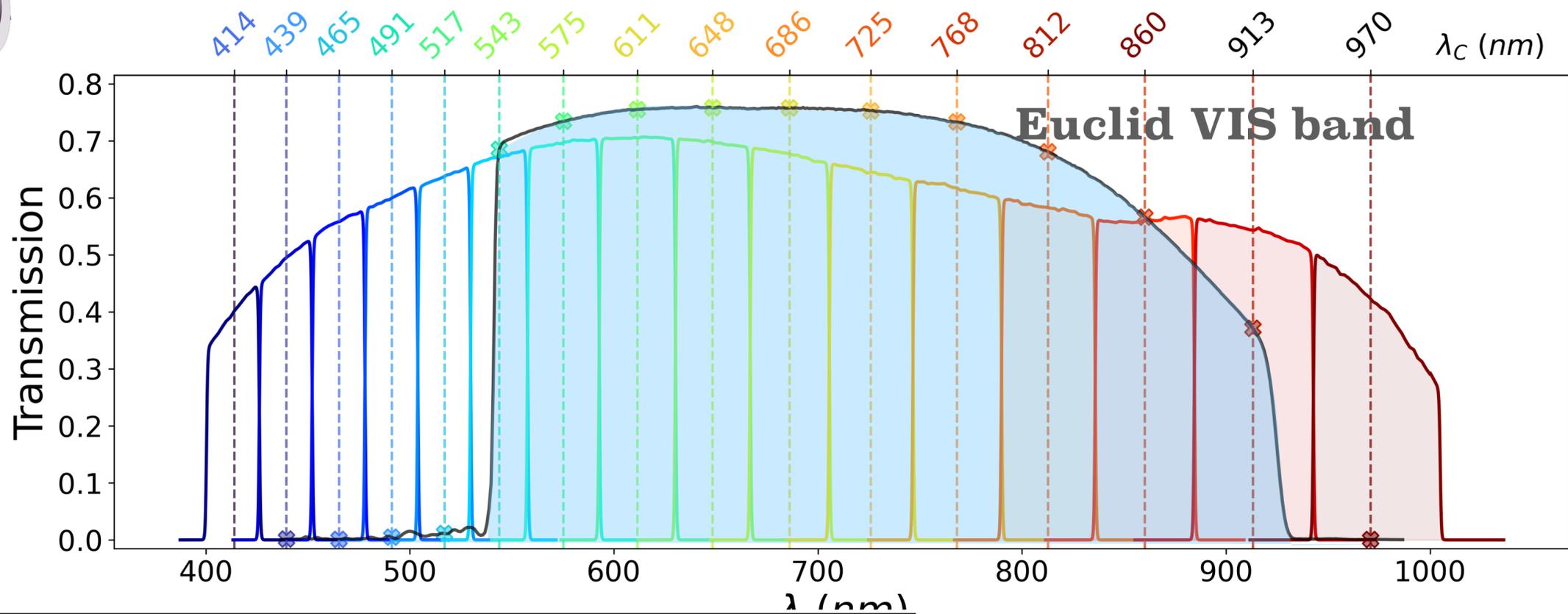




# Synergy with Euclid

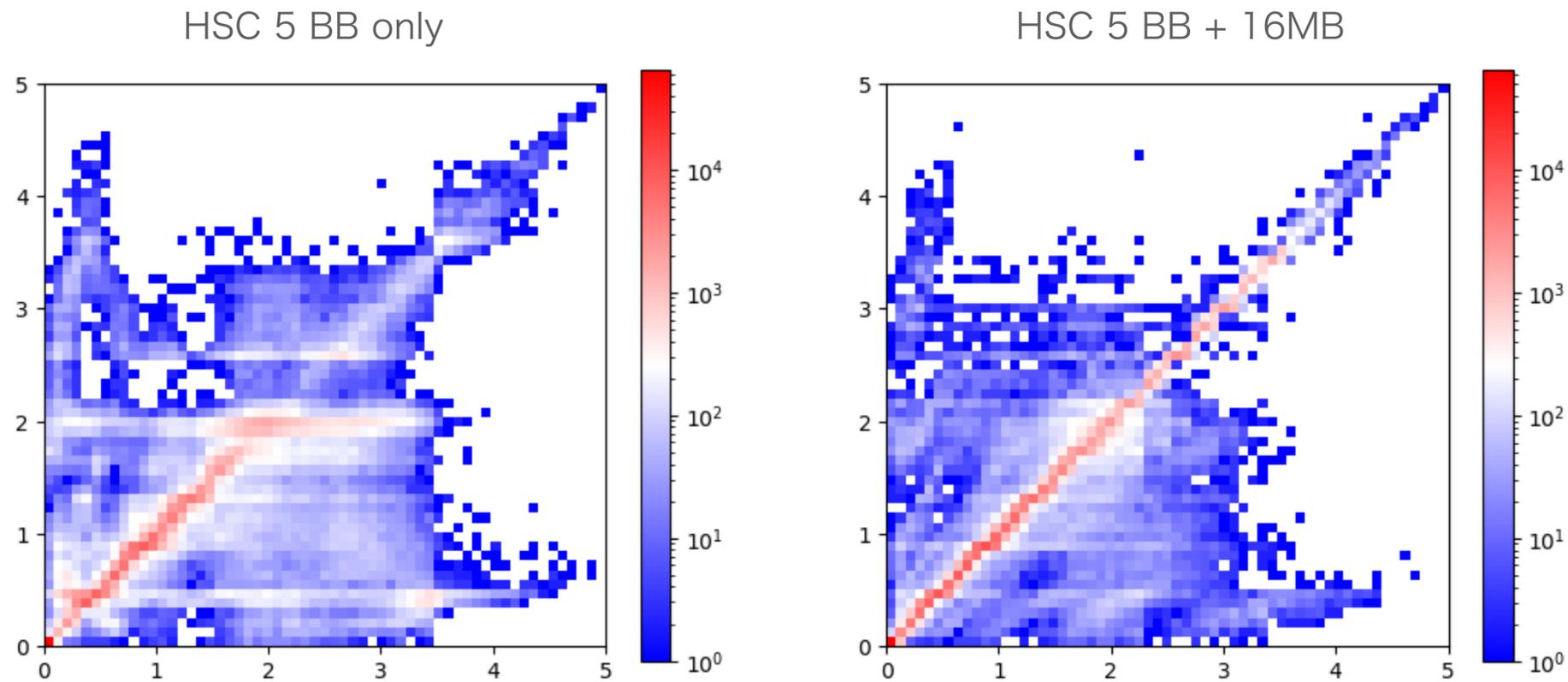


F. Tarsitano  
(Geneva -> ETH)



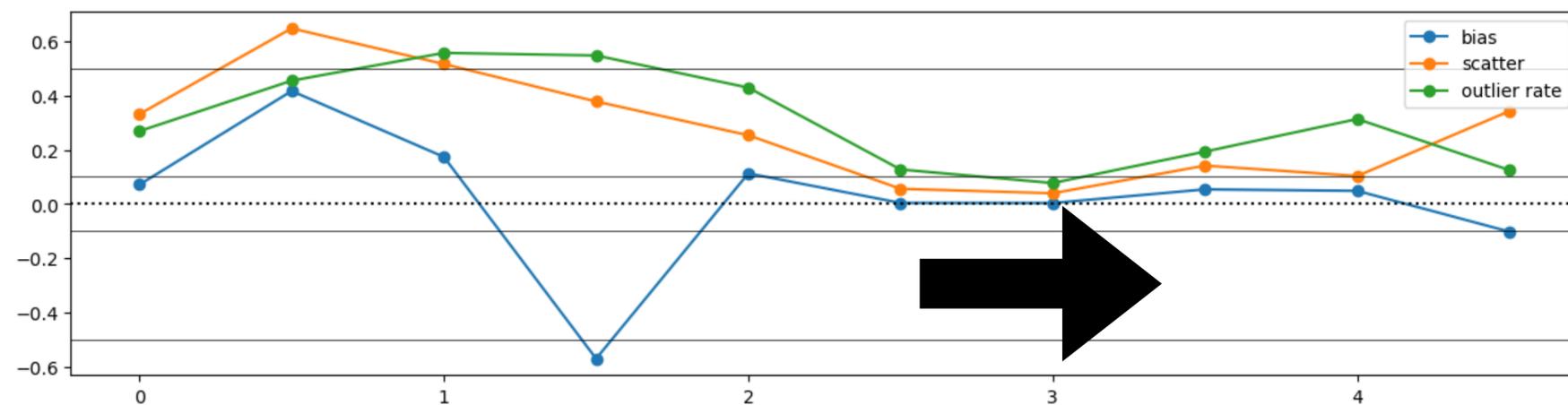
- Euclid will measure the galaxy shape with VIS-band (550-920nm)
- SED is reconstructed via GP w/ expected photometric errors
- wo 4 red filters, Euclid cannot meet the requirement (additive bias on gamma)

# photo-z improvement : BB -> BB+MB

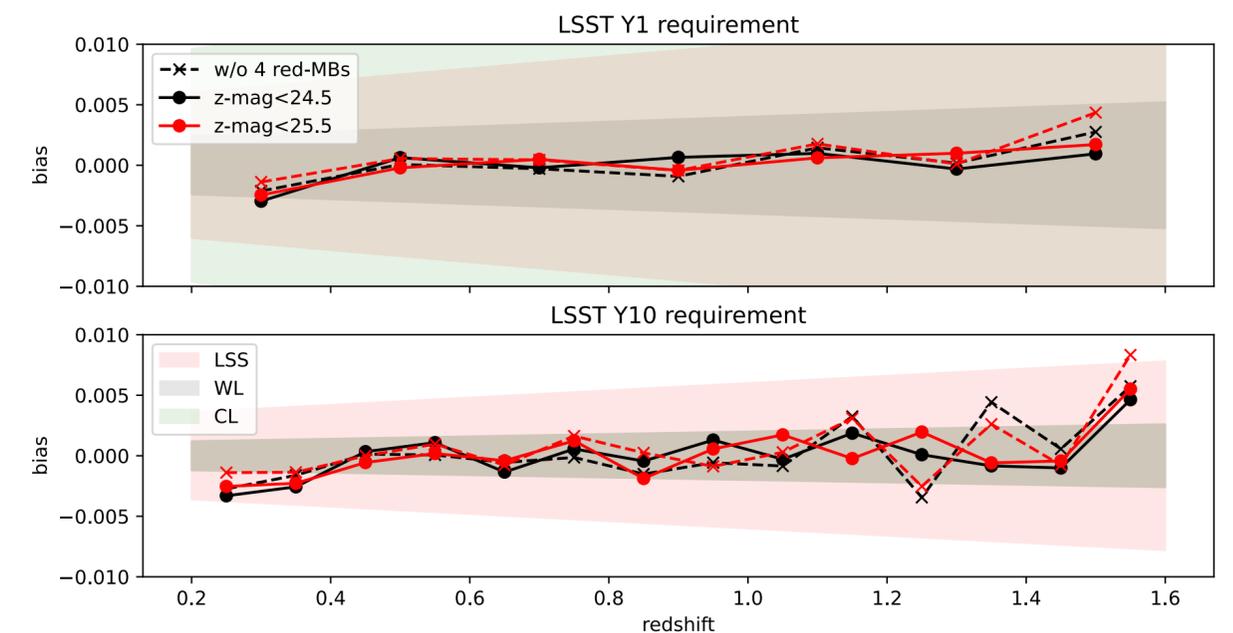


- EL-COSMOS synthetic spectra (w/ emission lines)
- convolve MB filters
- add noise (w/ 60 min. exposures)
- use flux only
- comparison to cosmos2020
- will meet the requirement for LSST-Y1 WL/LSS/cluster cosmology
- will also meet the requirement for LSST-Y10 LSS. (partly for WL/clusters)

$X_{\{5BB+16MB\}} / X_{\{5BB\}}$



significant improvement at higher-z



# 1st HSC MB workshop @ Nagoya, 2023 Sep. 1



# 2nd HSC MB workshop @ Nagoya, 2024 Nov. 27, 28



# 3rd HSC MB workshop @ Nagoya, 2025 Aug. 6-8

>70 people are involved !!



# Summary

- We will have 16 medium band filters on Subaru HSC
  - 12 MB filters are funded by JSPS International Leading Research (PI: S. Miyazaki)
  - The first set (MBQ-1) has been delivered to Hawaii (available from S26A CfP)
  - The reddest 4 MB filters are funded by NSF (PI: E. Egami)
- MB filters will have a legacy value for training/calibrating the photo-z for upcoming deep imaging surveys by 2030. (Roman, LSST, Euclid, ...)
- Not only the photo-z training/calibration, it may be useful for many science cases. Many discussions among various fields have been discussed over the past three HSC MB workshops.
- Fabrication status for other MBs
  - MBQ<sub>2</sub>, MBQ<sub>3</sub> : order placed and will be delivered <Mar. 2026 to Mitaka
  - Holders for MBQ<sub>2,3</sub> are already ordered and delivered to Mitaka.
  - MBQ<sub>4</sub> : wait for the order /solid limit of delivery to June 2026. -> will be available from S27A/B CfP