HSC

Subaru Imaging Survey

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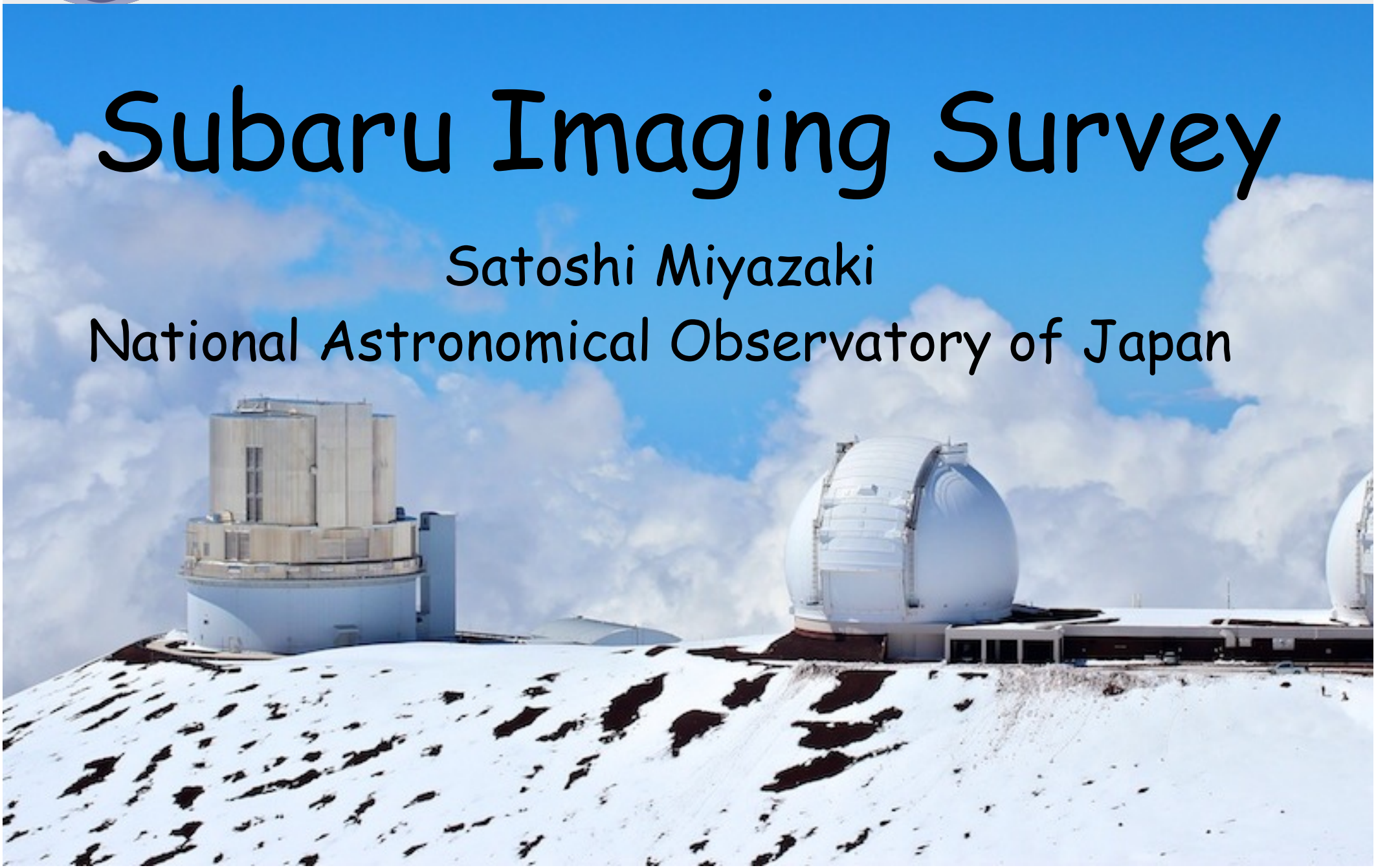
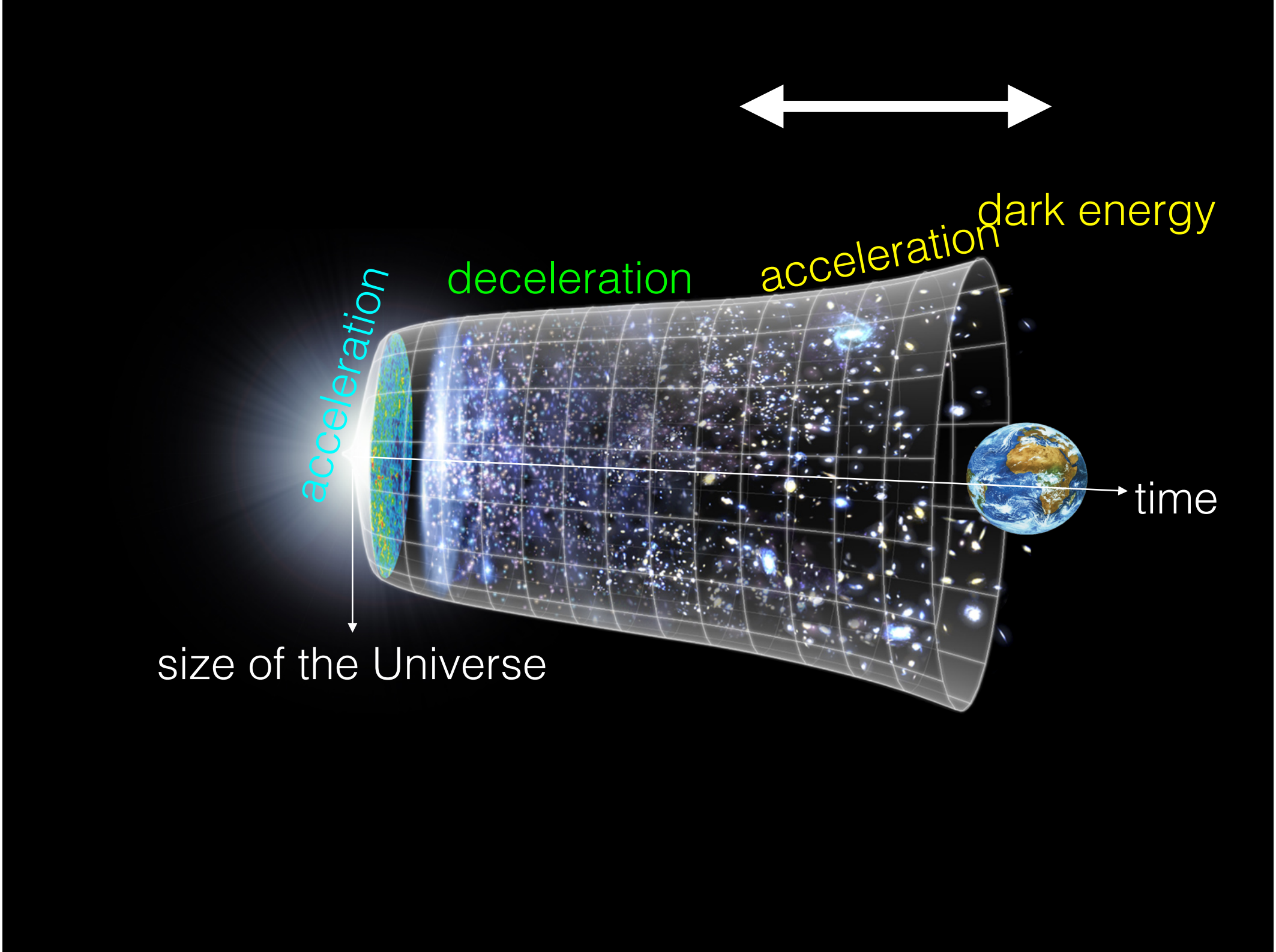
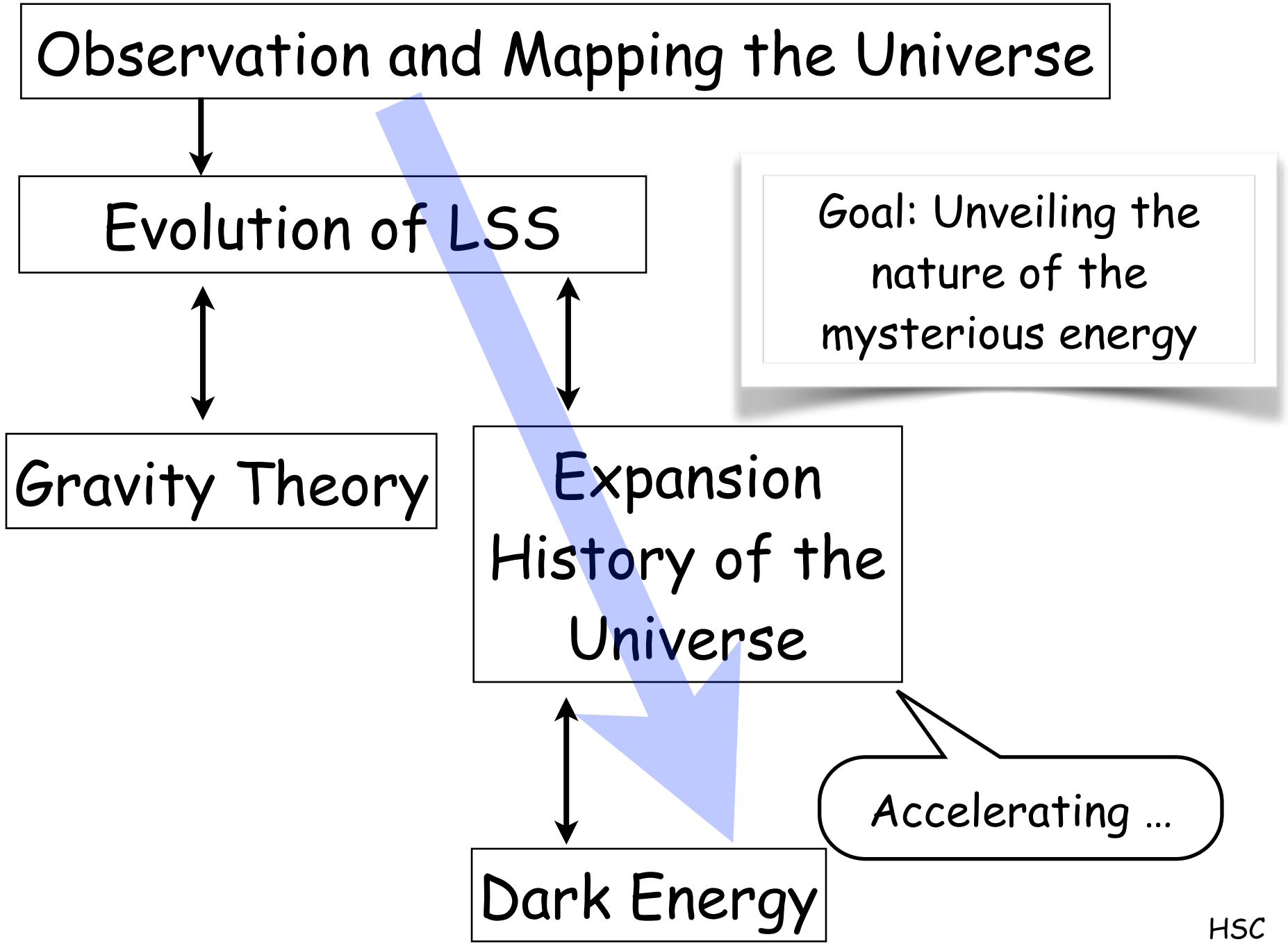
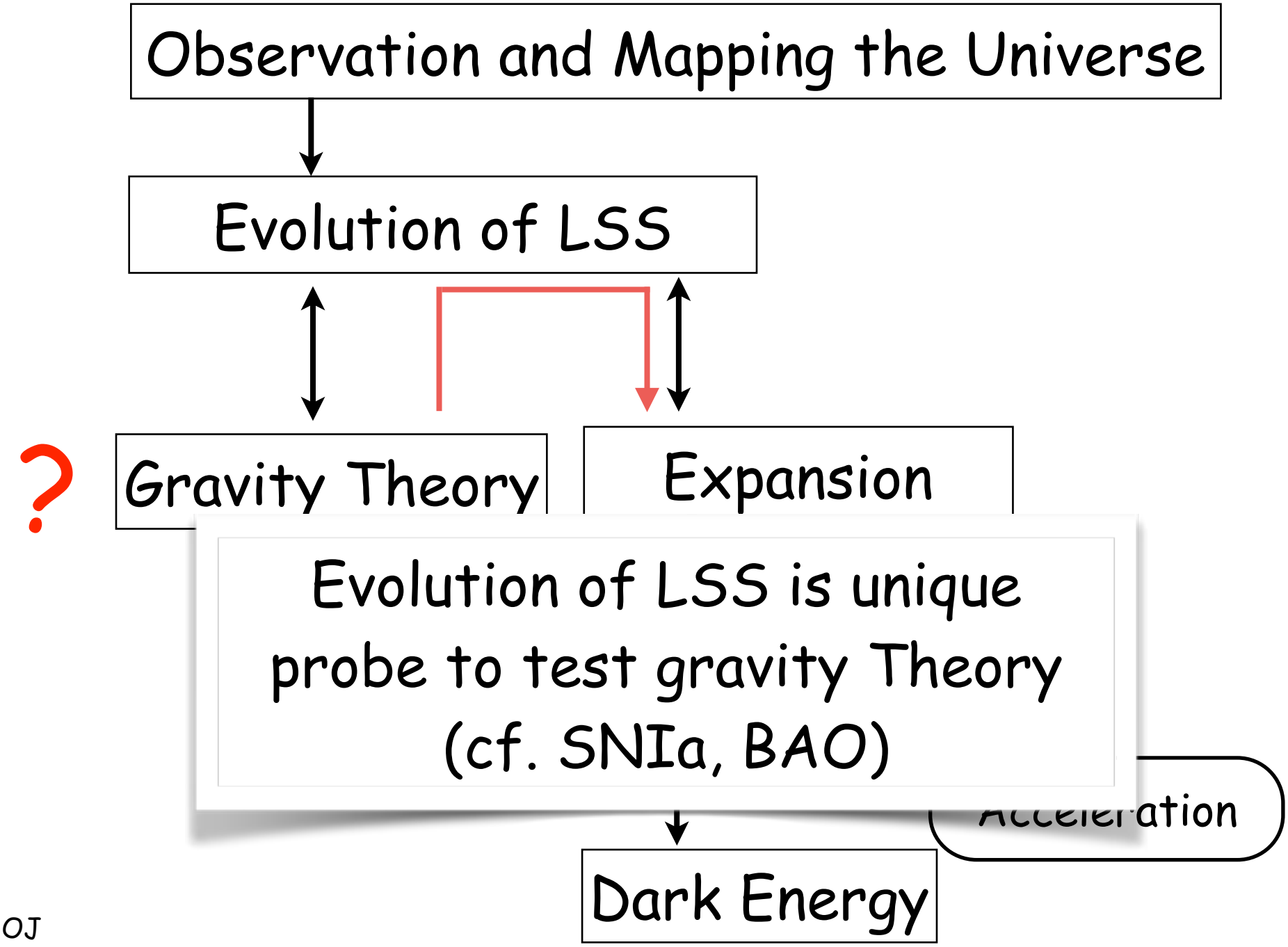



dark energy
acceleration
deceleration
acceleration
time
size of the Universe

Imaging Survey & DE

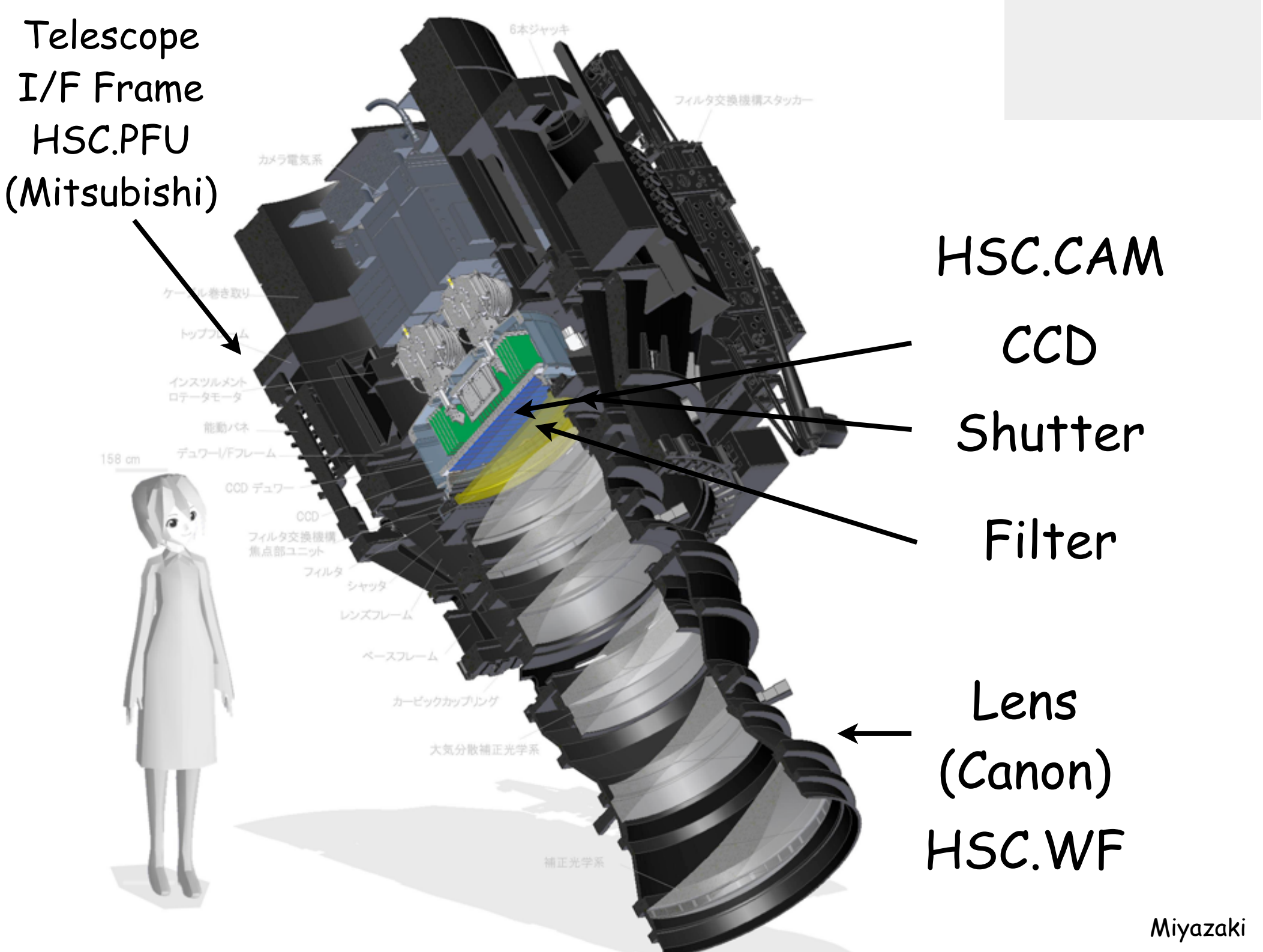


DE or Modified Gravity ?



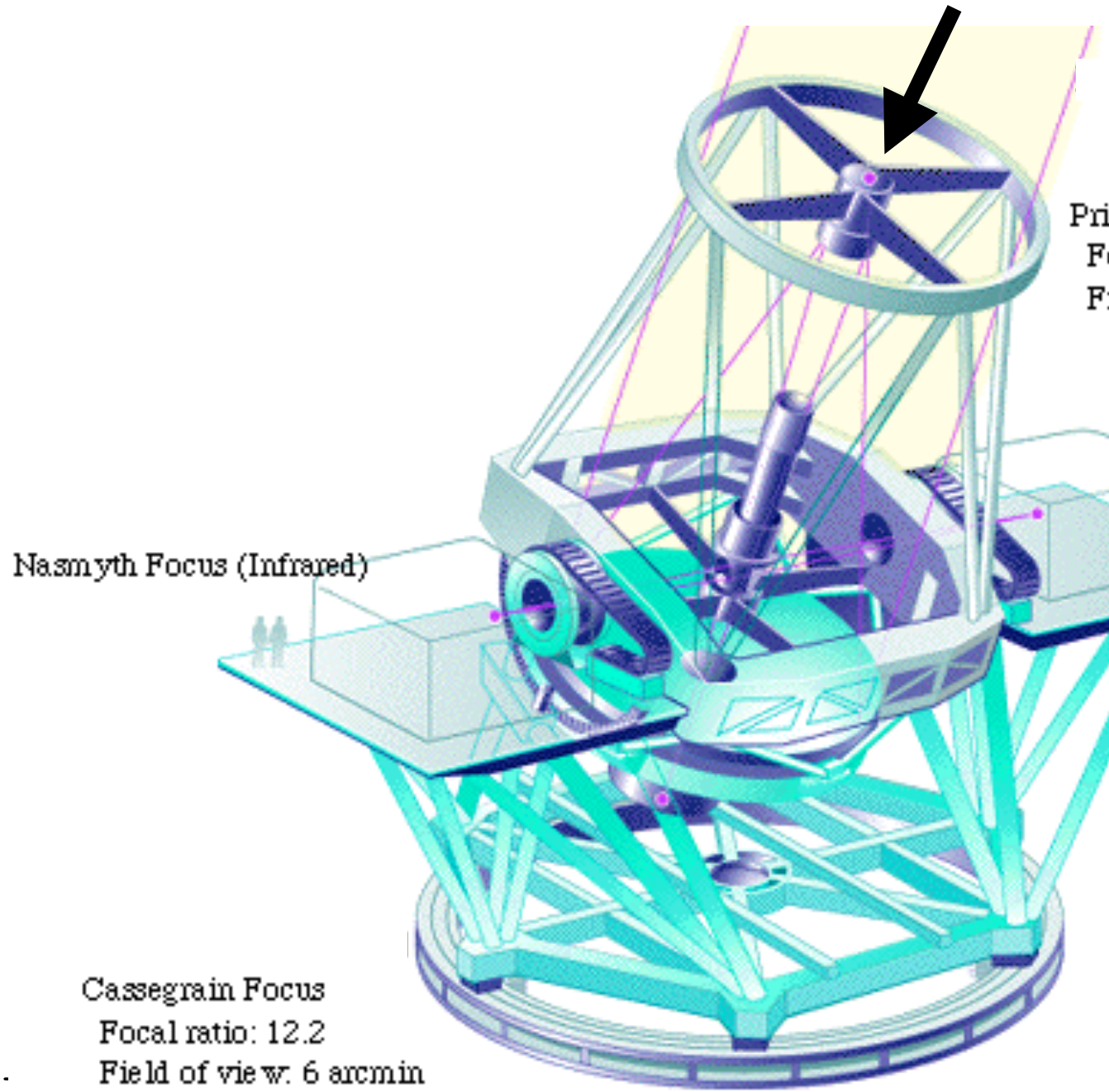
Weak Lensing

- Weak Lensing technique is employed to measure LSS of dark matter distribution directly.
  - Tomographic Cosmic Shear
    - Standard: Other project (DES) can do as well
  - Clusters of Galaxies
    - Harder to observe the lensing effect: Sharp & Deep imaging required.


Telescope
I/F Frame
HSC.PFU
(Mitsubishi)
HSC.CAM
CCD
Shutter
Filter
Lens
(Canon)
HSC.WF
158 cm
6本ジャッキ
フィルタ交換機構スタッカー
カメラ電気系
ケーブル巻き取り
トップフレーム
インスツルメント
ロテータモータ
能動バネ
デュワーI/Fフレーム
CCD デュワー
CCD
フィルタ交換機構
焦点部ユニット
フィルタ
シャッタ
レンズフレーム
ベースフレーム
カービックカップリング
大気分散補正光学系
補正光学系

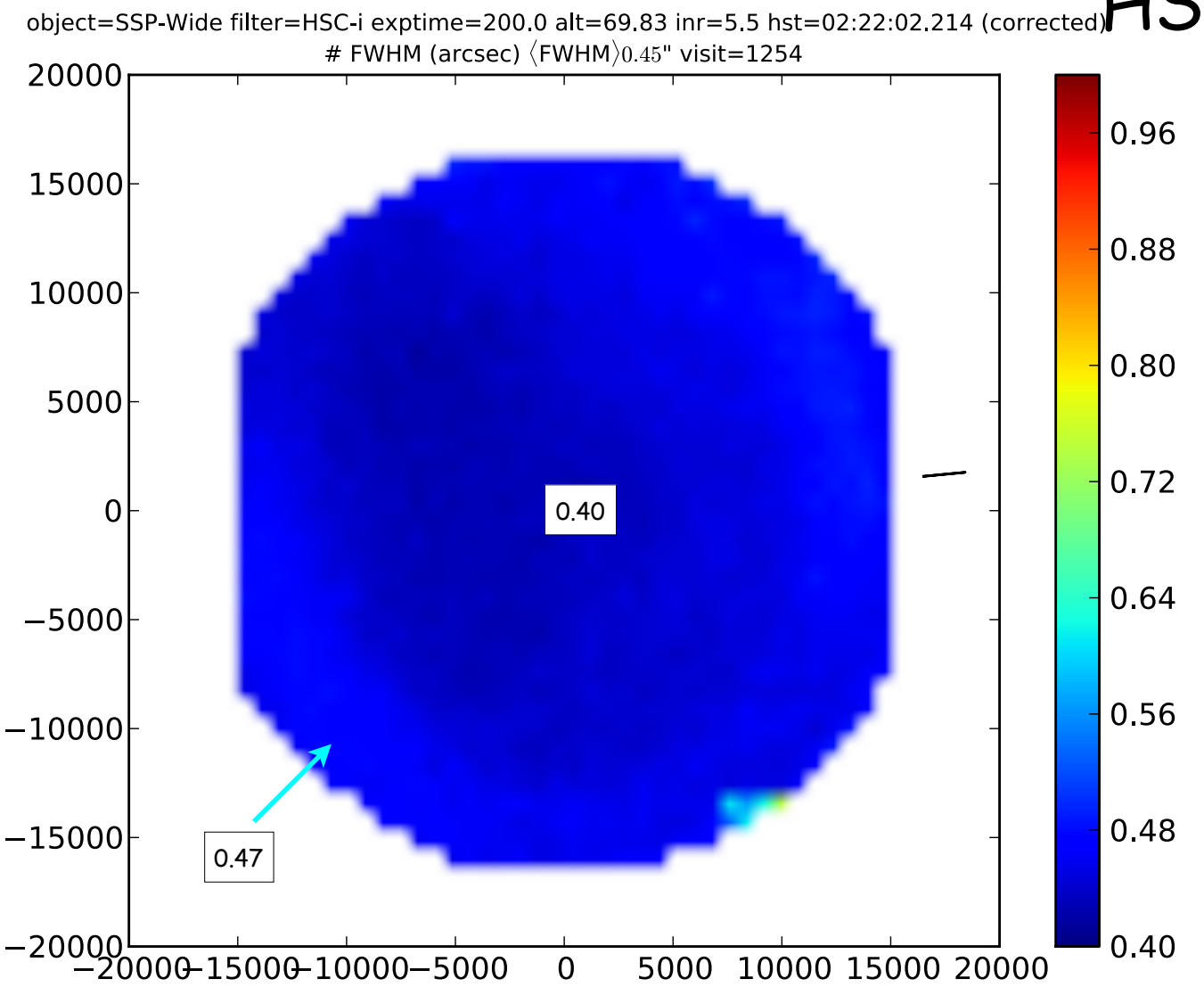
Miyazaki

Subaru Telescope



PSF Evaluation

HSC-i 200 sec

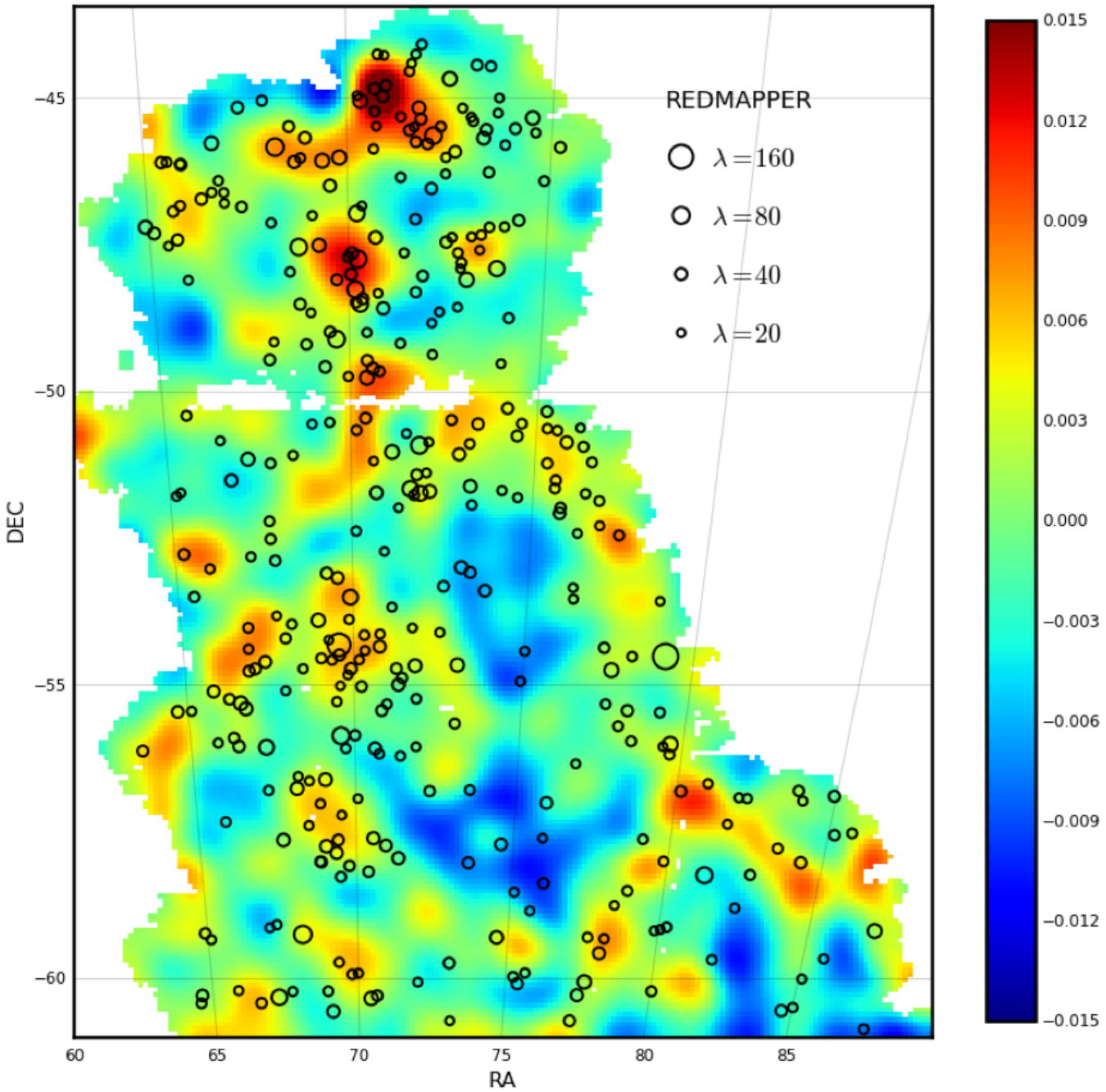


Very Sharp Image Realized as designed

Wide Survey Projects

		Depth	Width (deg^2)	<IQ> (arcsec)
CFHTLensS	Completed	25.0	170	0.75
Pan-STARRS	on-going	25.4	70	~ 1.1
DES	on-going	25.2	5,000	~ 1.0
HSC	on-going	26.2	1,500	0.67

Dark Energy Survey WL map



Chang et al. (2015) PRL

139 deg2

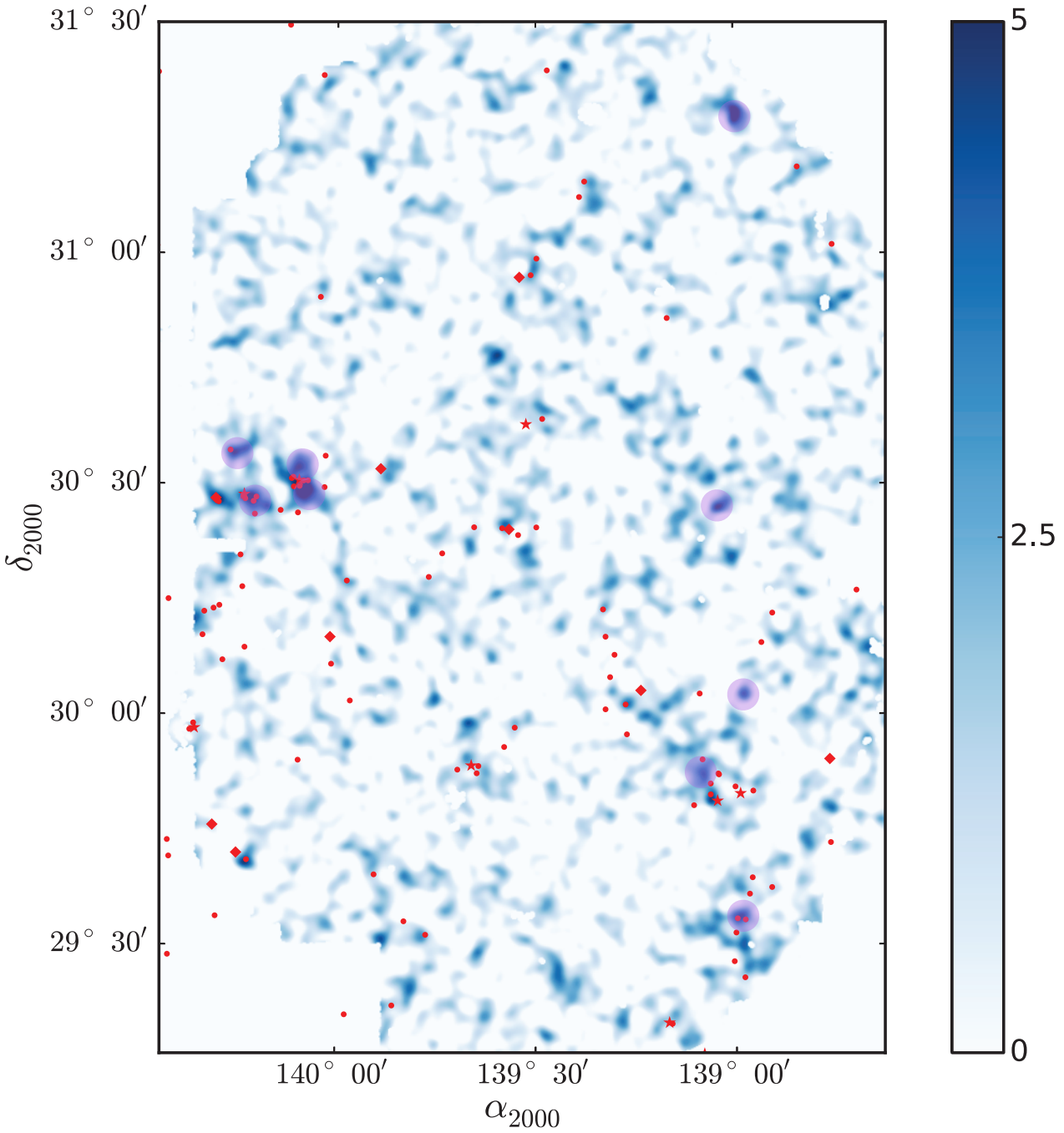
- Moon
- ○ Clusters

Trace matter distribution globally

but

Cluster not resolved

WL map by HSC



know GC

Individual Clusters resolved

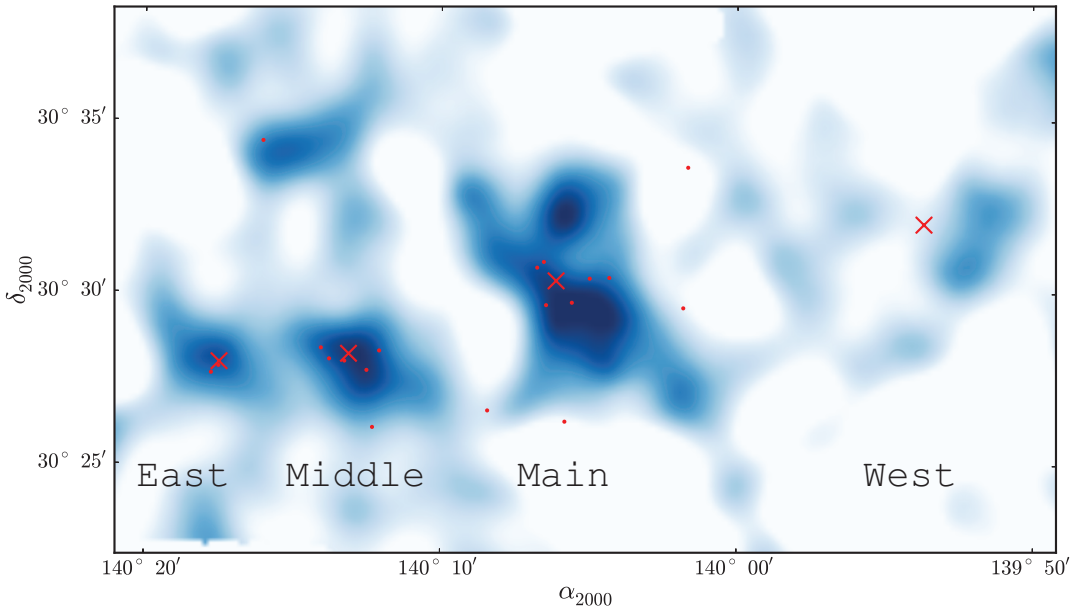
10 times higher angular resolution

SN 〉 4.5 Peaks

Miyazaki et al. (2015)

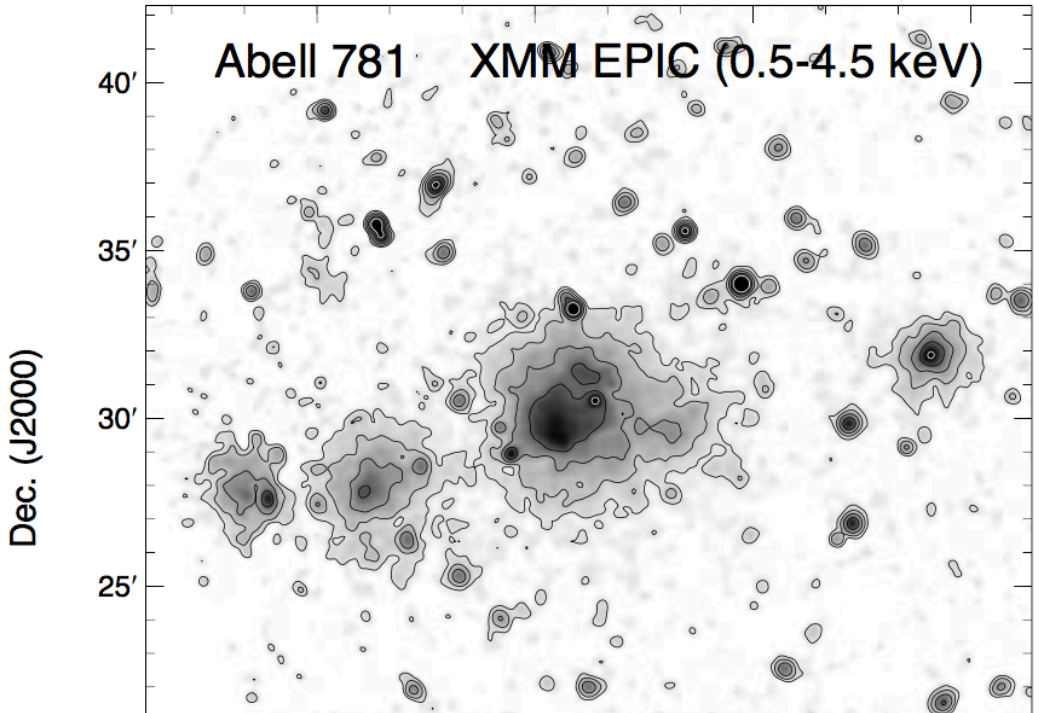
Abell 781Region (z=0.3)

HSC

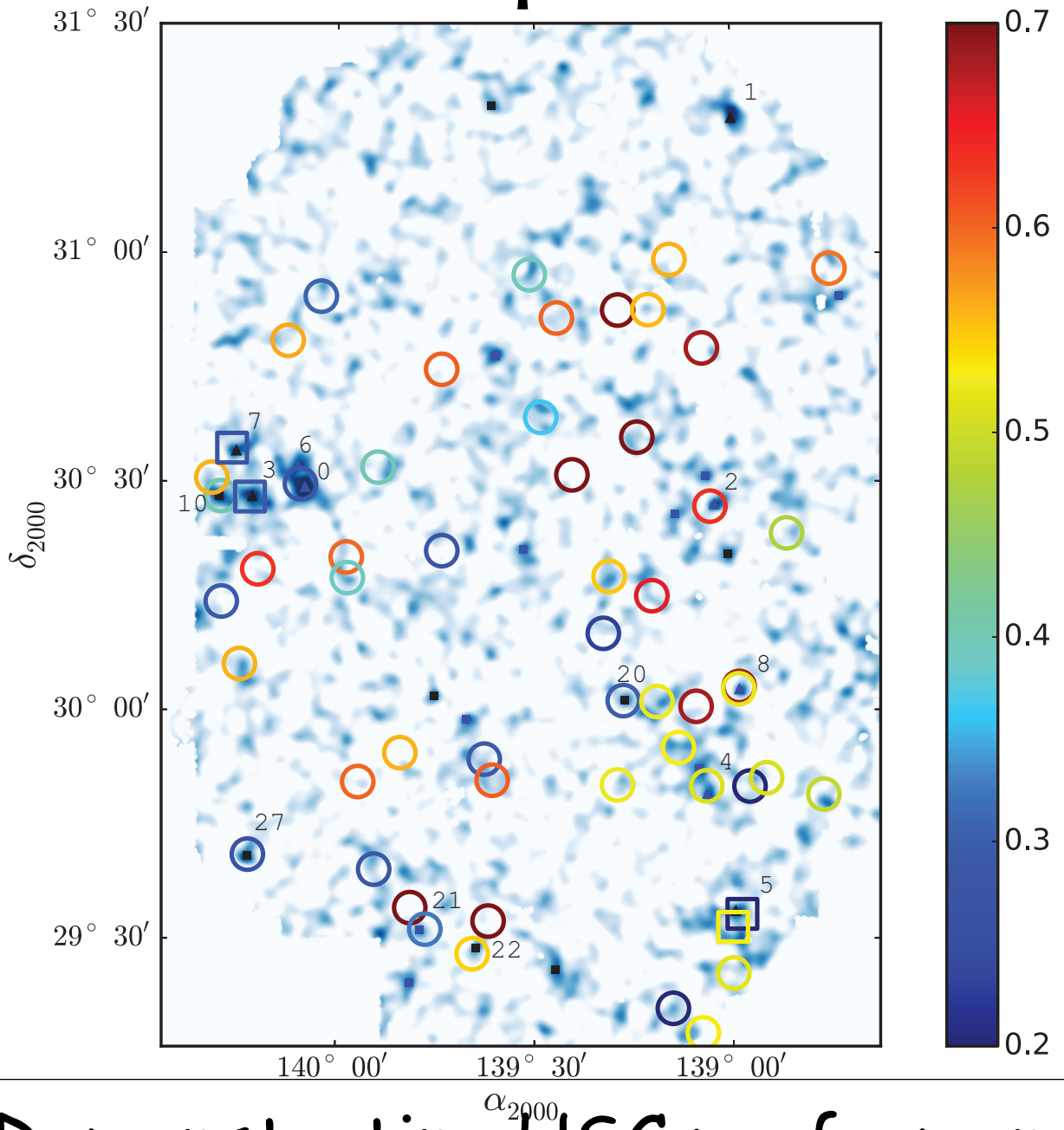


Angular resolution ~ X-ray cluster size

XMM



Optical Clusters



Peaks on Kappa

▲ SN >= 4.5

■ 4.5>SN>=3.7

Optical Clusters by CAMIRA

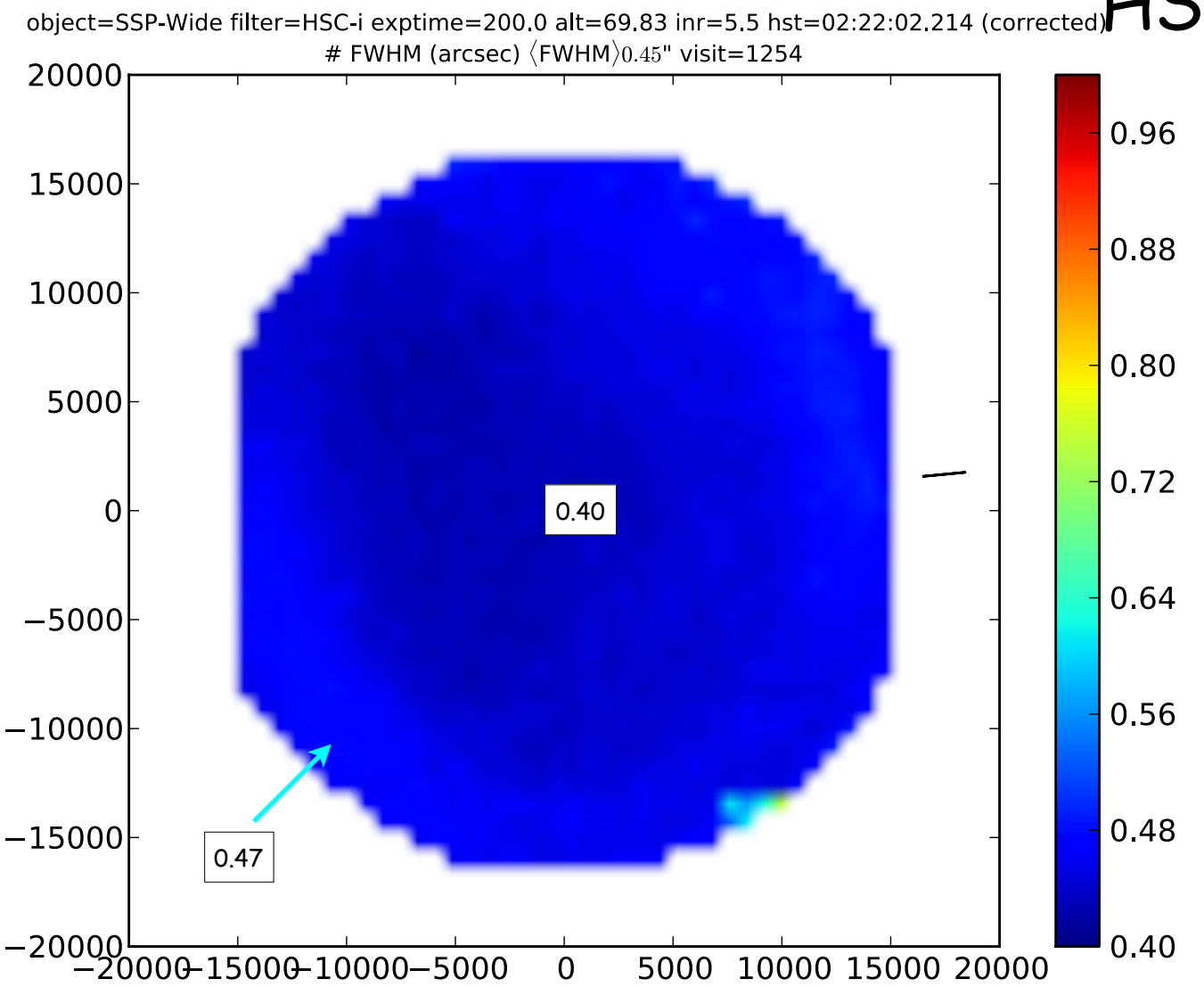
○

All the significant peaks have physical associations

Demonstrating HSC performance in Cluster Lensing

PSF Evaluation

HSC-i 200 sec

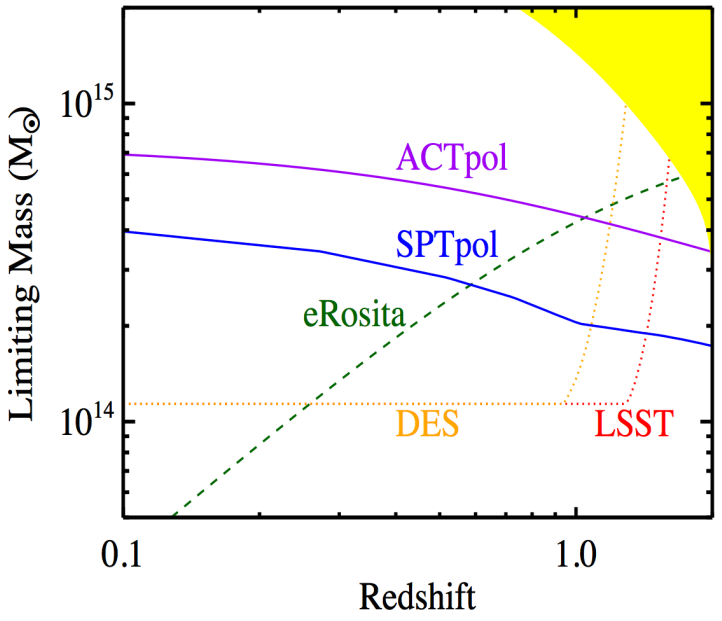


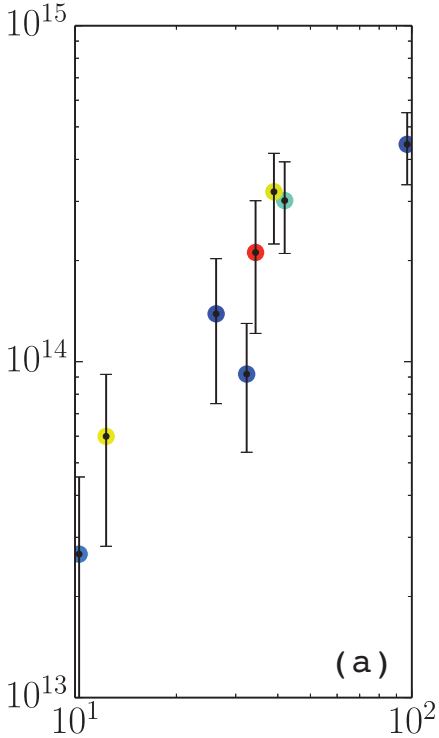
Very Sharp Image Realized as designed

Generating Cluster Catalogs

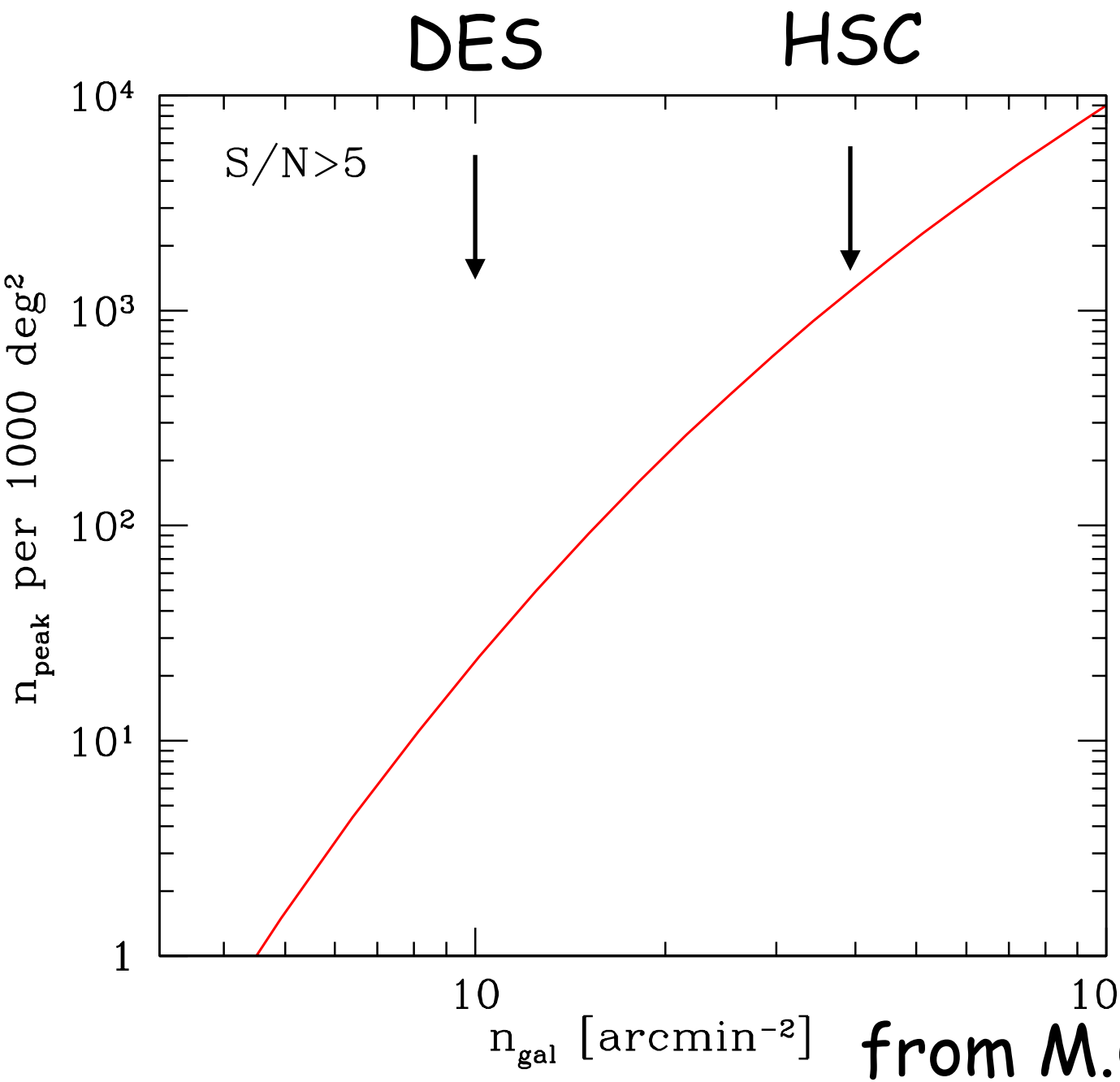
- Cluster identifications by optical method
- Group the clusters by the (richness, redshift)
- Stack the shears in the group to measure (average) mass precisely
- -> Cosmology

Multi-band optical deep imaging is truly complimentary to X-ray survey



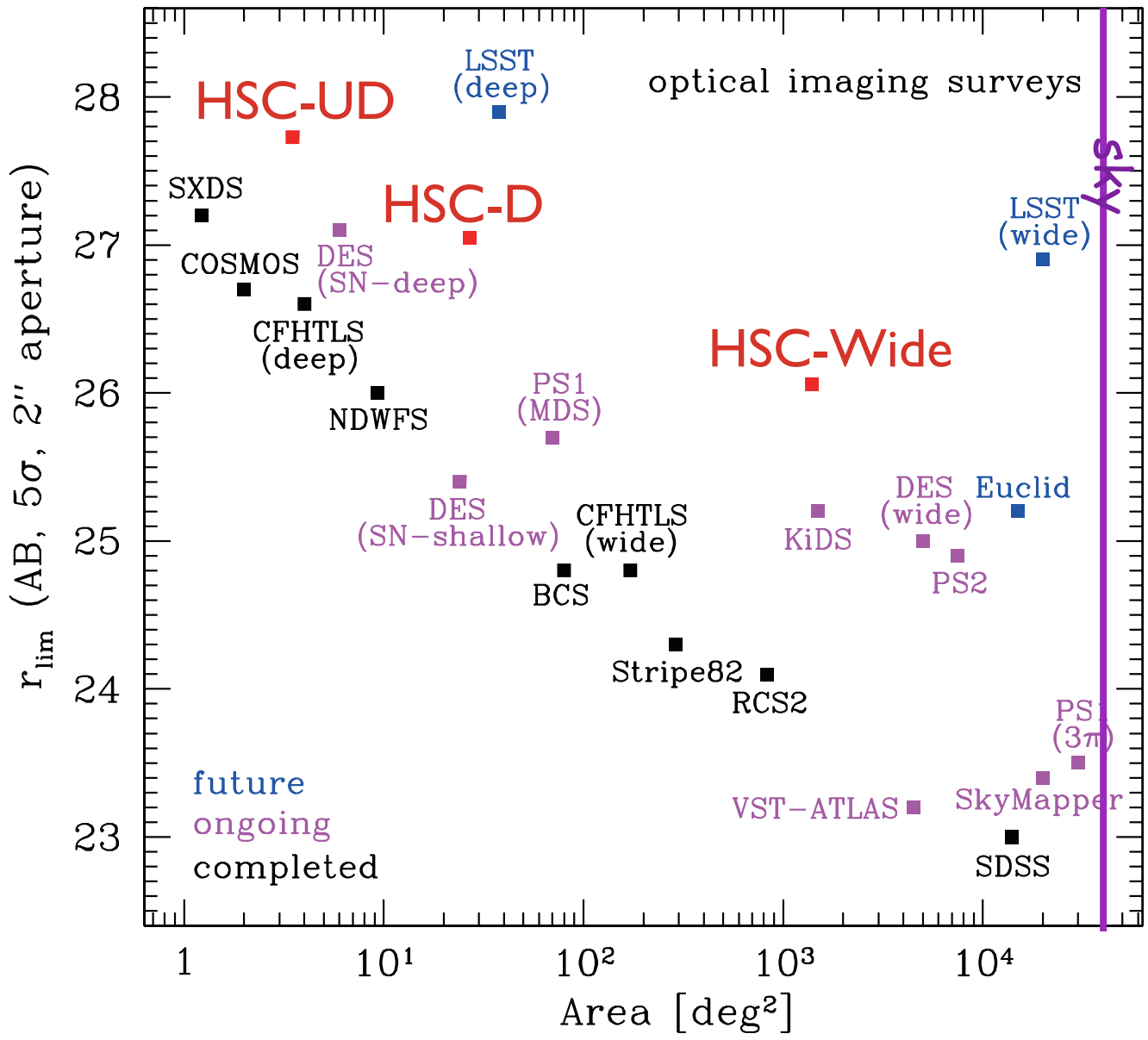


Number Density vs Peaks



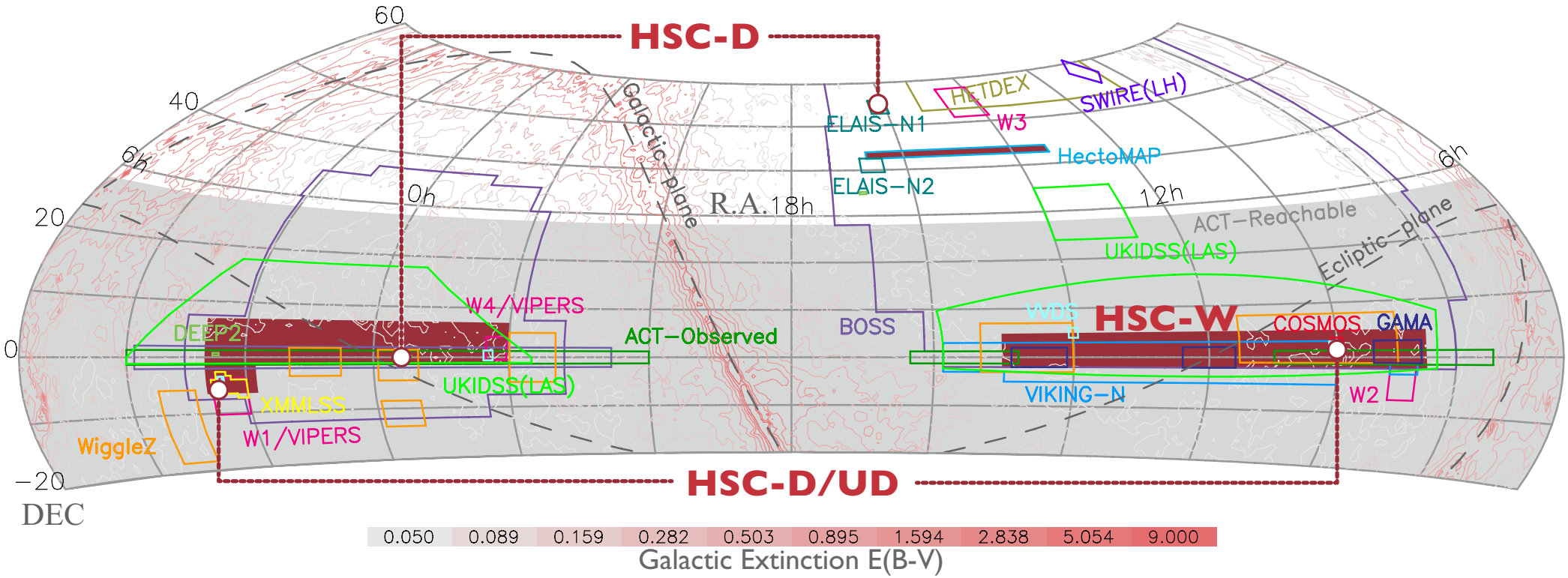
from M.Oguri

HSC SSP Survey: Three layers



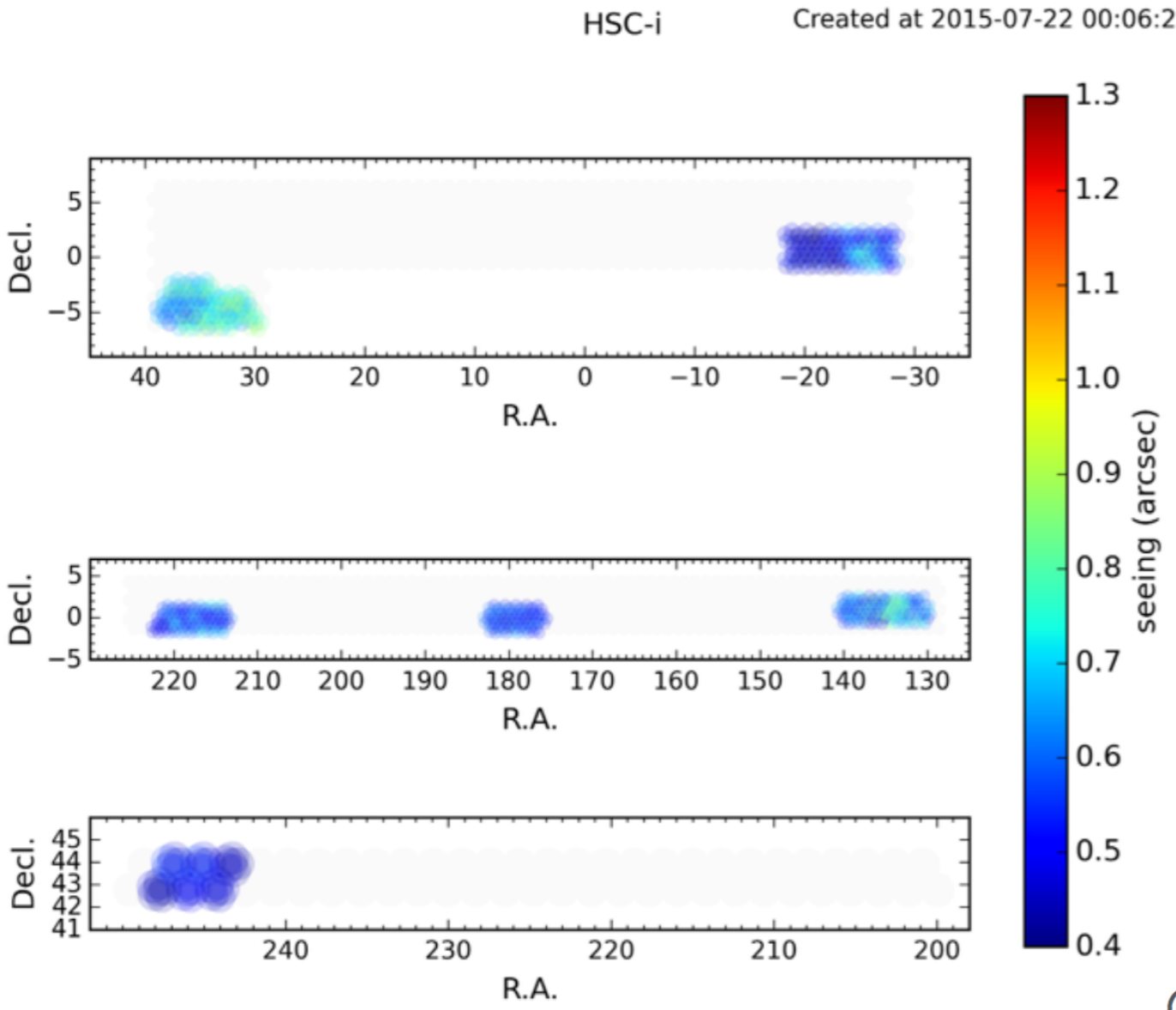
- Three-tier survey
  - Wide: 1400 sq. degs, i~26
  - Deep: 28 sq. degs, i~27
  - Ultradeep: 3 sq. degs, i~27.7

Survey Field



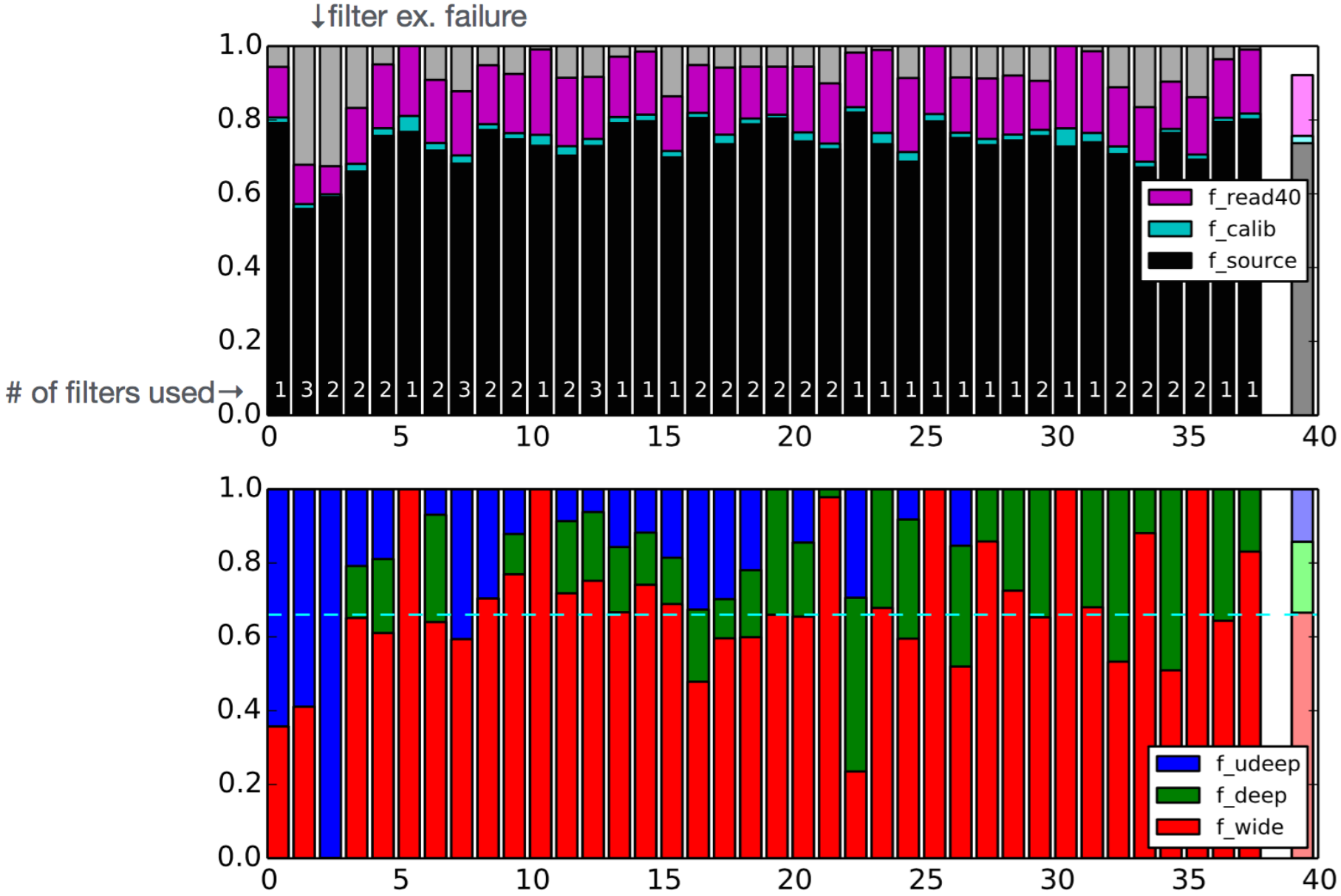
- SDSS Field
- Least dusty
- Well spread in RA)
- Useful Data set
  - Atacama Cosmology Telescope CMB, Survey SDSS/BOSS, spectroscopic data, NIR, X-ray

summary of the current status



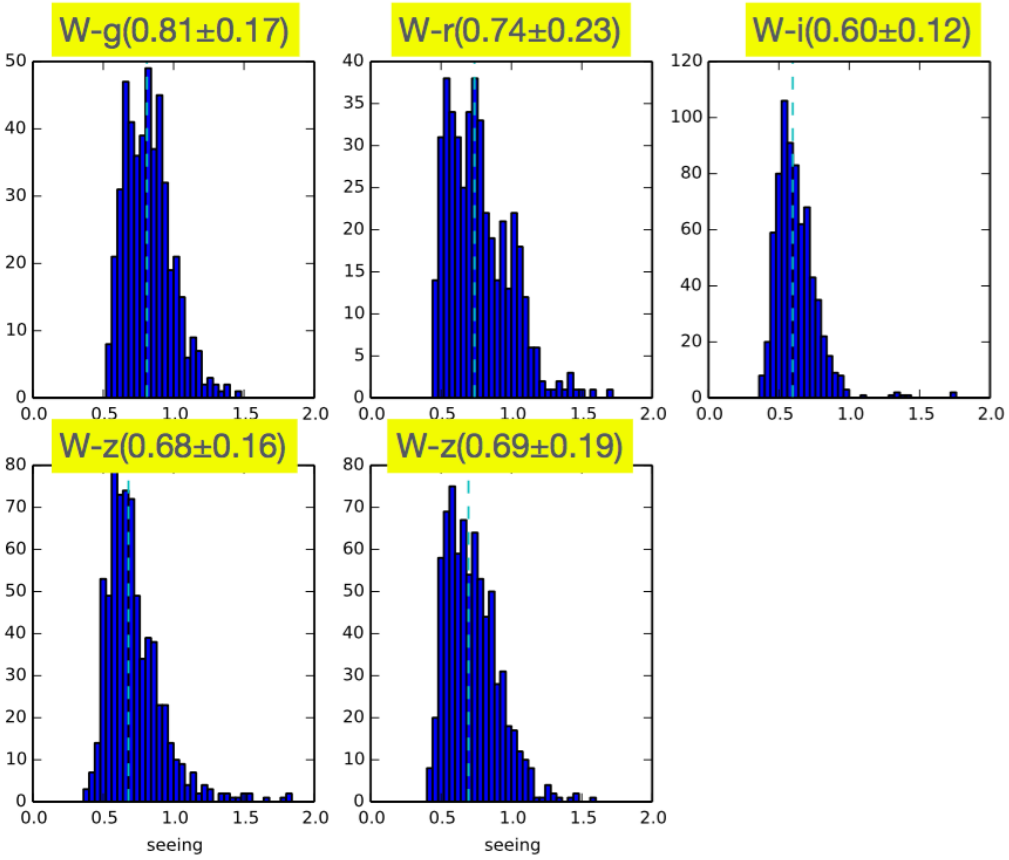
© N. Yasuda

breakdown fractional



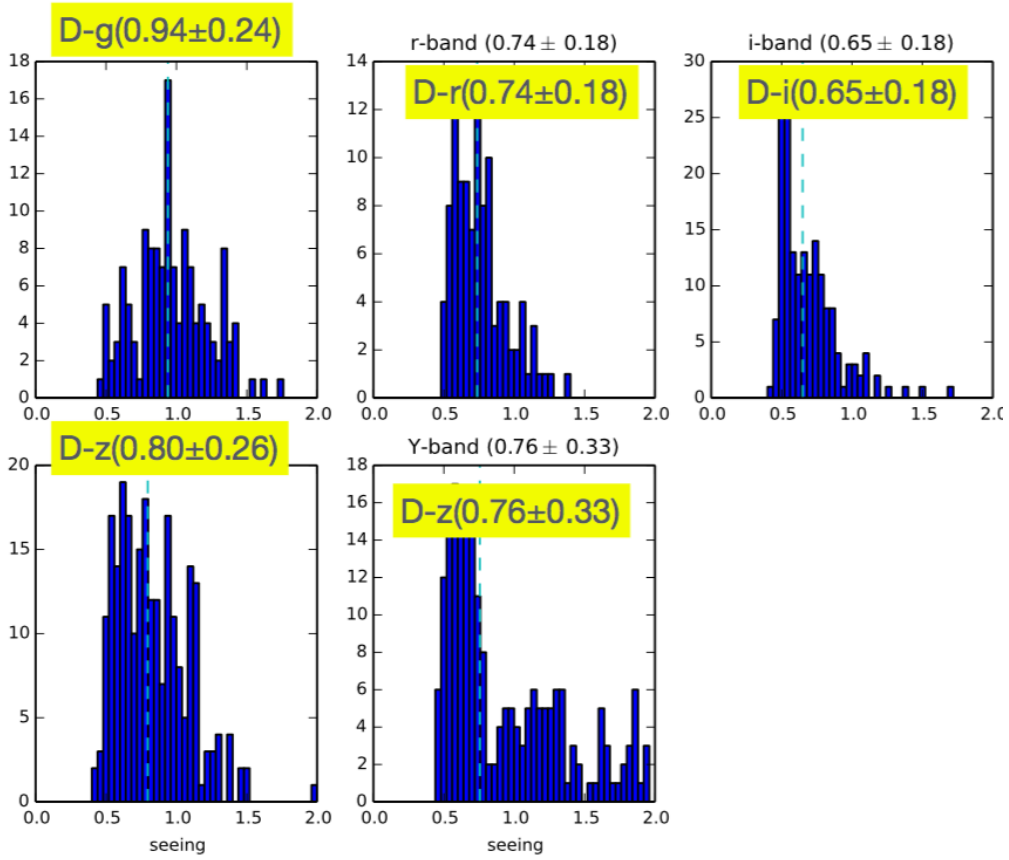
seeing distributions

HSC-Wide



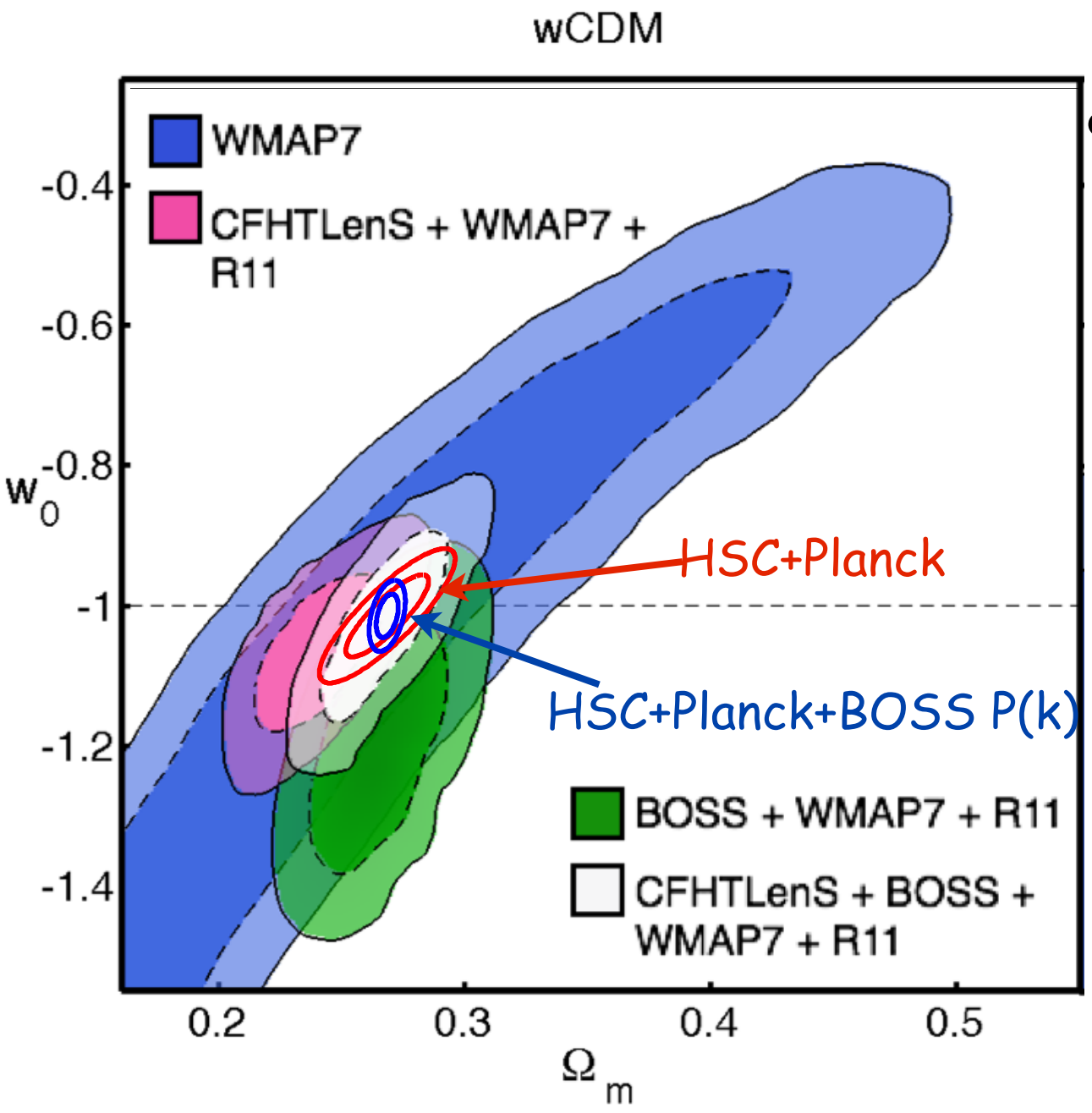
FWHM<0.7(g)=27%
FWHM<0.7(r) =40%
FWHM<0.7(i) =75%
FWHM<0.7(z)=56%
FWHM<0.7(Y)=51%

HSC-Deep/Ultra-Deep



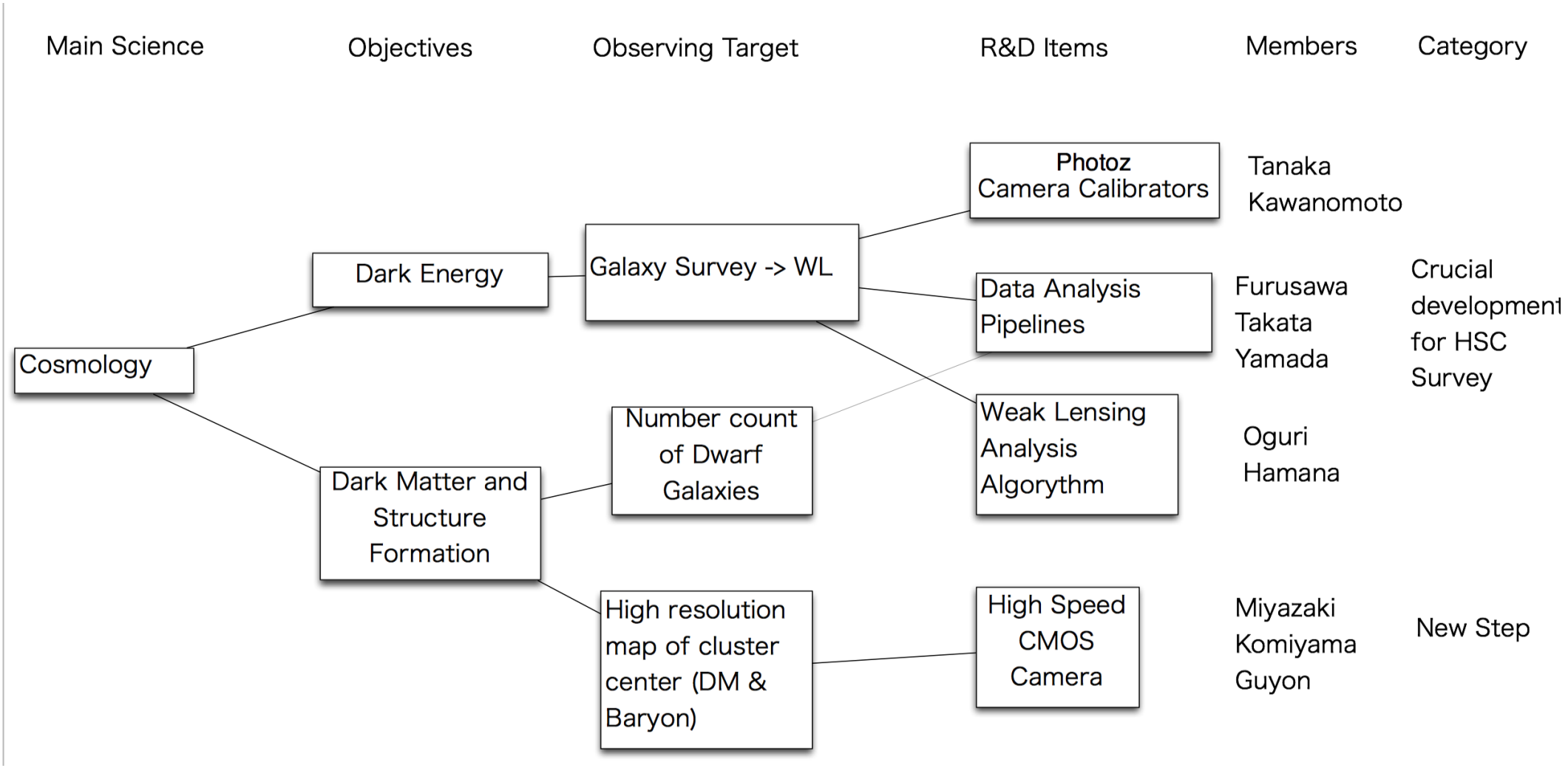
FWHM<0.7(g)=17%
FWHM<0.7(r) =40%
FWHM<0.7(i) =58%
FWHM<0.7(z)=36%
FWHM<0.7(Y)=42%

Cosmology through WL (Forecast)



- 3 times improvement compared with CFHT Lensing Survey (Heymans et al. 13): 154deg2、2003-2008

B02 Sub project

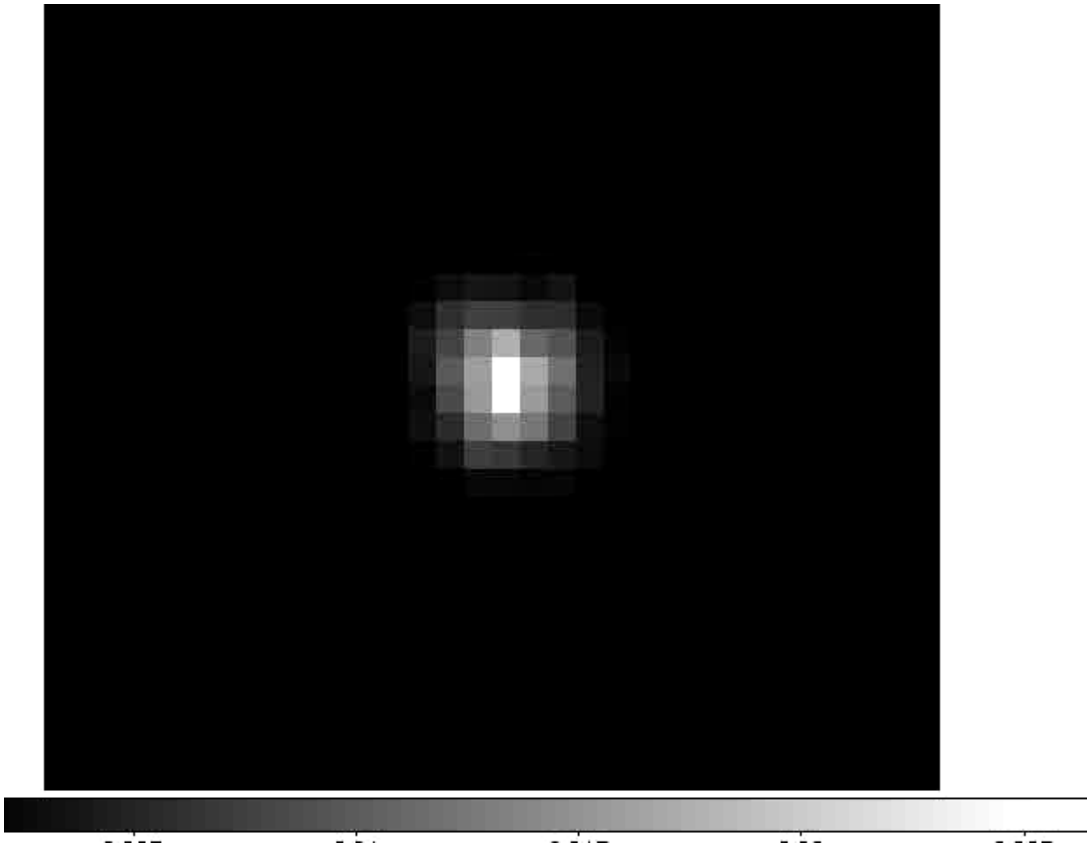


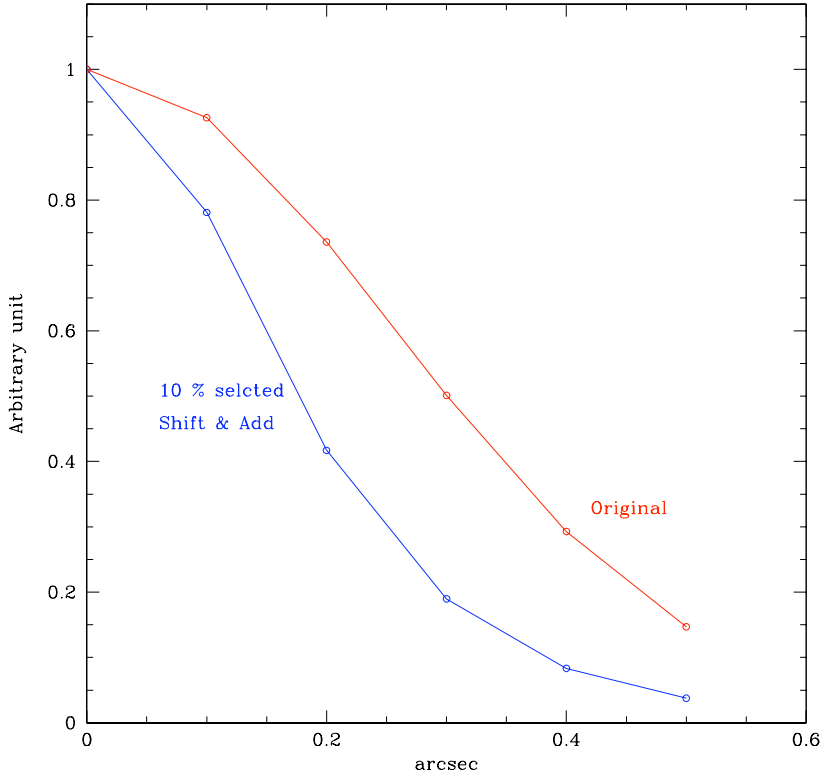
Lucky Imaging to improve images

To increase number density of resolved galaxies

- 0.1 arcsec/pix
- 10 % luckily good image
  - Seeing0".6 -> 0".3
- 15 Hz readout
- isoplanatic patch ~ 1 arcmin
- Field coverage ~ 50 % of 30' FOV

Simulation

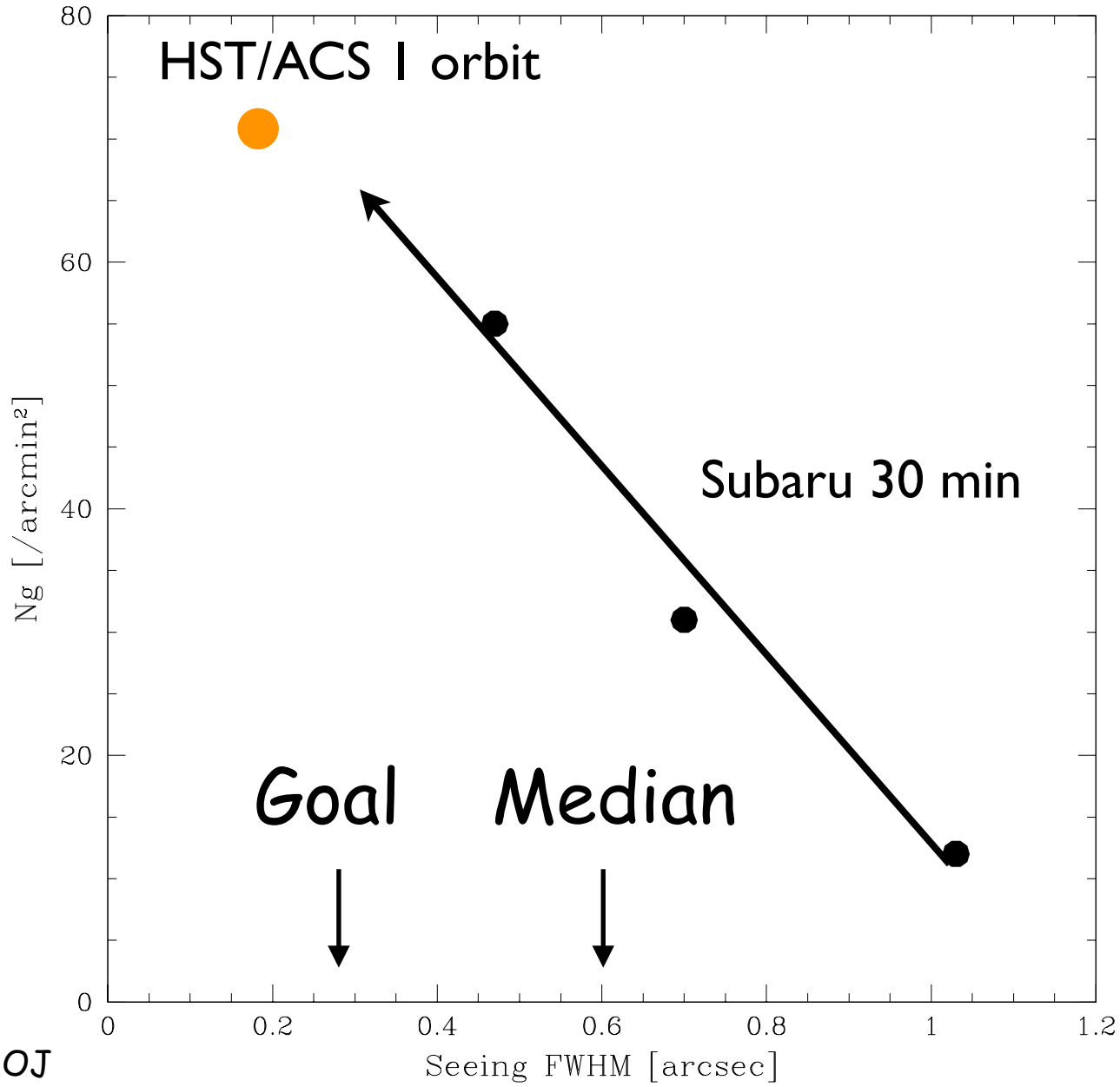




Guyon, Garrel, Miyazaki in prep.

Merit of better Seeing

Number of faint galaxies used for weak lensing analysis



High resolution Imaging of Cluster Centers

Displacement of DM (WL) and Baryon (X-ray)

To measure Cross section of self-interaction of DM

Conclusion

- Subaru Imaging Survey underway
  - HSC: 3 tons 3 m tall ~ 1Gpixel Digital Camera for 8.2 m Telescope
- 5 years Survey to measure LSS for cosmology
- Uniquely using clusters of galaxies by taking advantage of sharp and deep imaging
- Shear measurement technique & Photo-z being developed
- New sensor and camera planned to probe the nature of dark matter