B02
Subaru Imaging Survey

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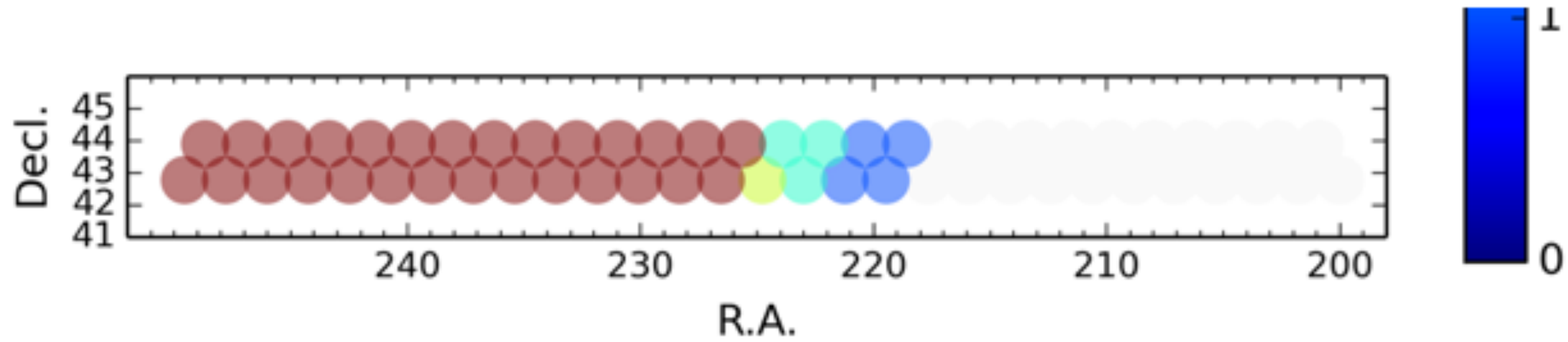
National Astronomical Observatory of Japan

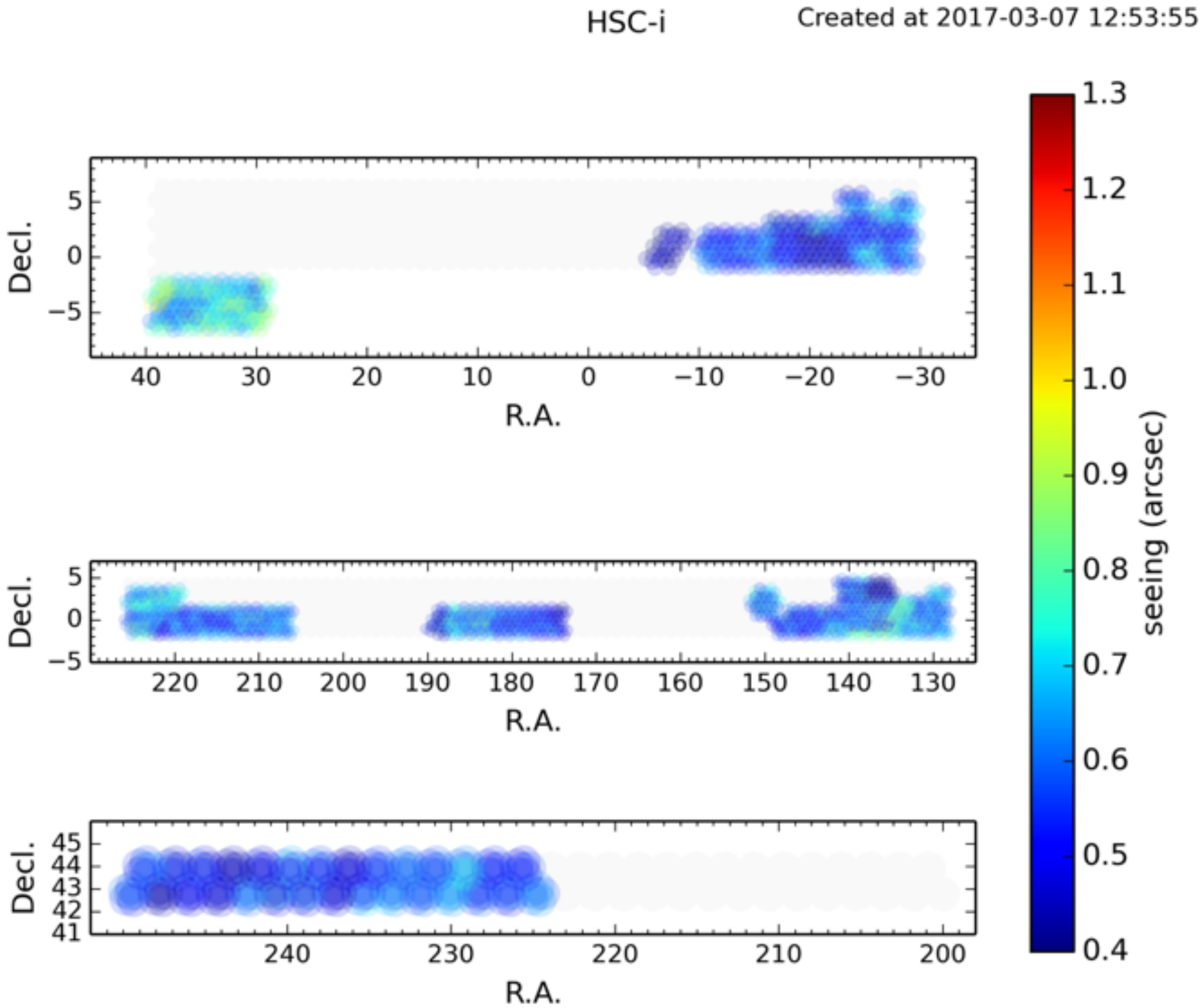
2017/03/09 Shingakujutsu Symposium

Full depth area Created at 2017-03-07 12:58:41

Covered area to full depth

band (total exptime)	area (deg^2)	Finished pointings	Updated
g (10min = 150sec x 4)	429.0	1472 / 3672	2017 Feb 01
r (10min = 150sec x 4)	462.7	1593 / 3672	2017 Mar 06
i (20min = 200sec x 6)	327.1	1774 / 5508	2017 Mar 06
z (20min = 200sec x 6)	410.7	2196 / 5508	2017 Mar 04
Y (20min = 200sec x 6)	332.0	1843 / 5508	2017 Mar 04
Full color	269.0		2017 Mar 06

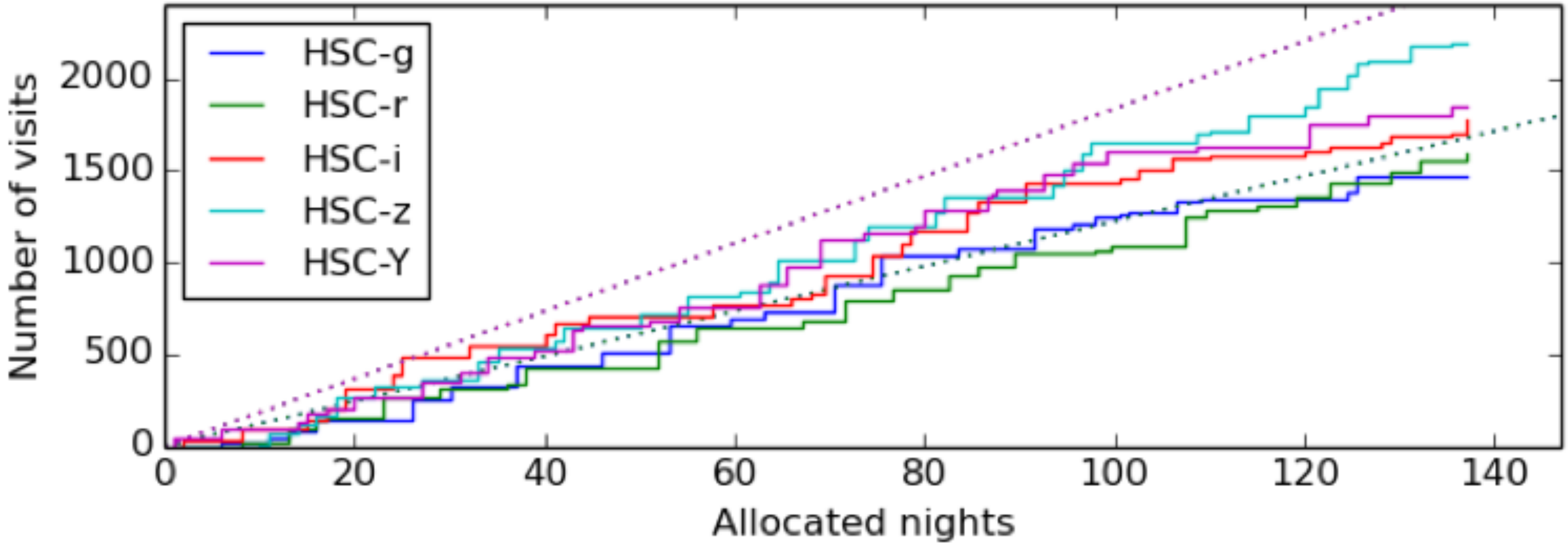




HSC-i
Created at 2017-03-07 12:53:55
Decl.
R.A.
seeing (arcsec)

HSC Survey Progress

Created at 2017-03-07 13:03:14

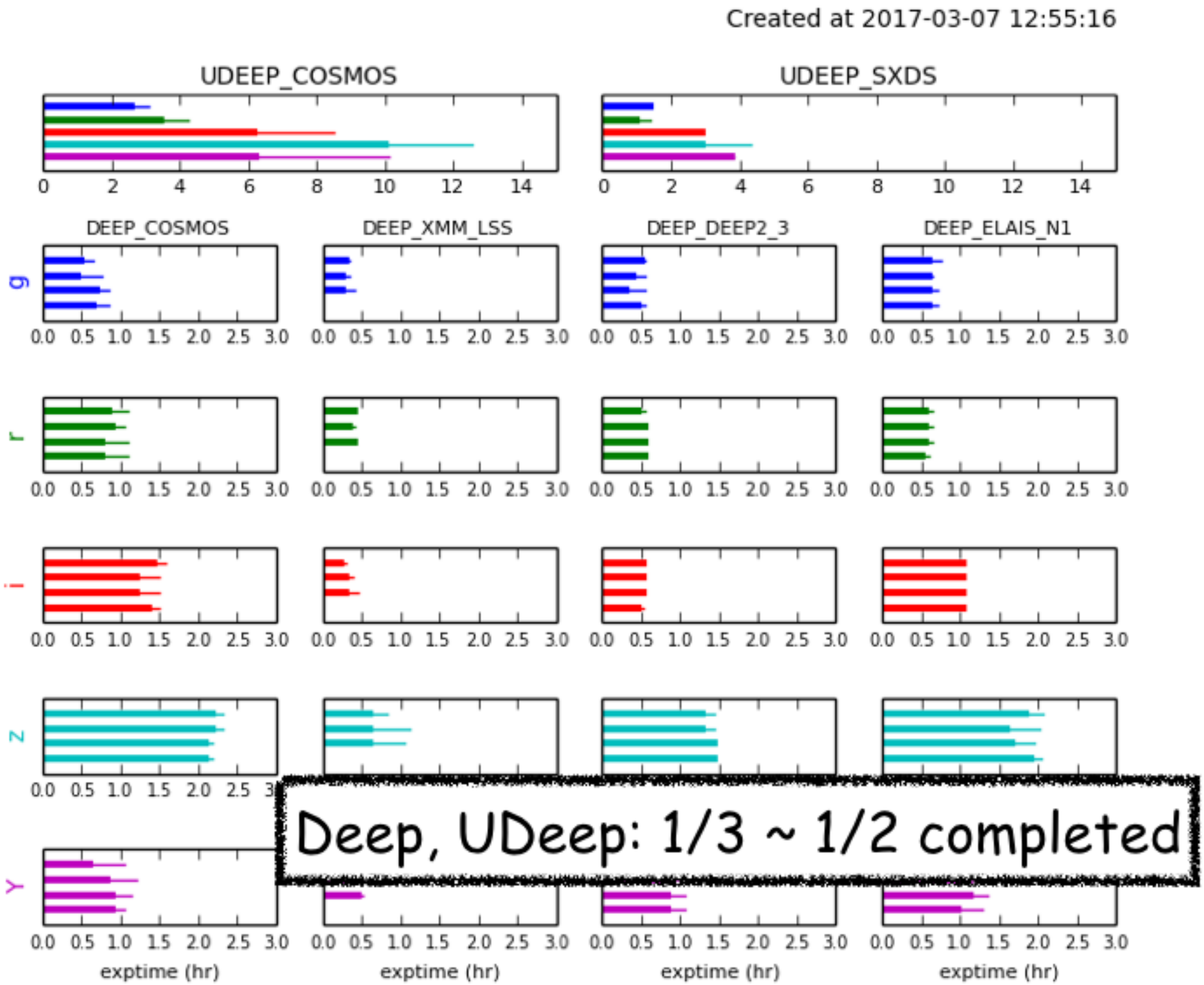


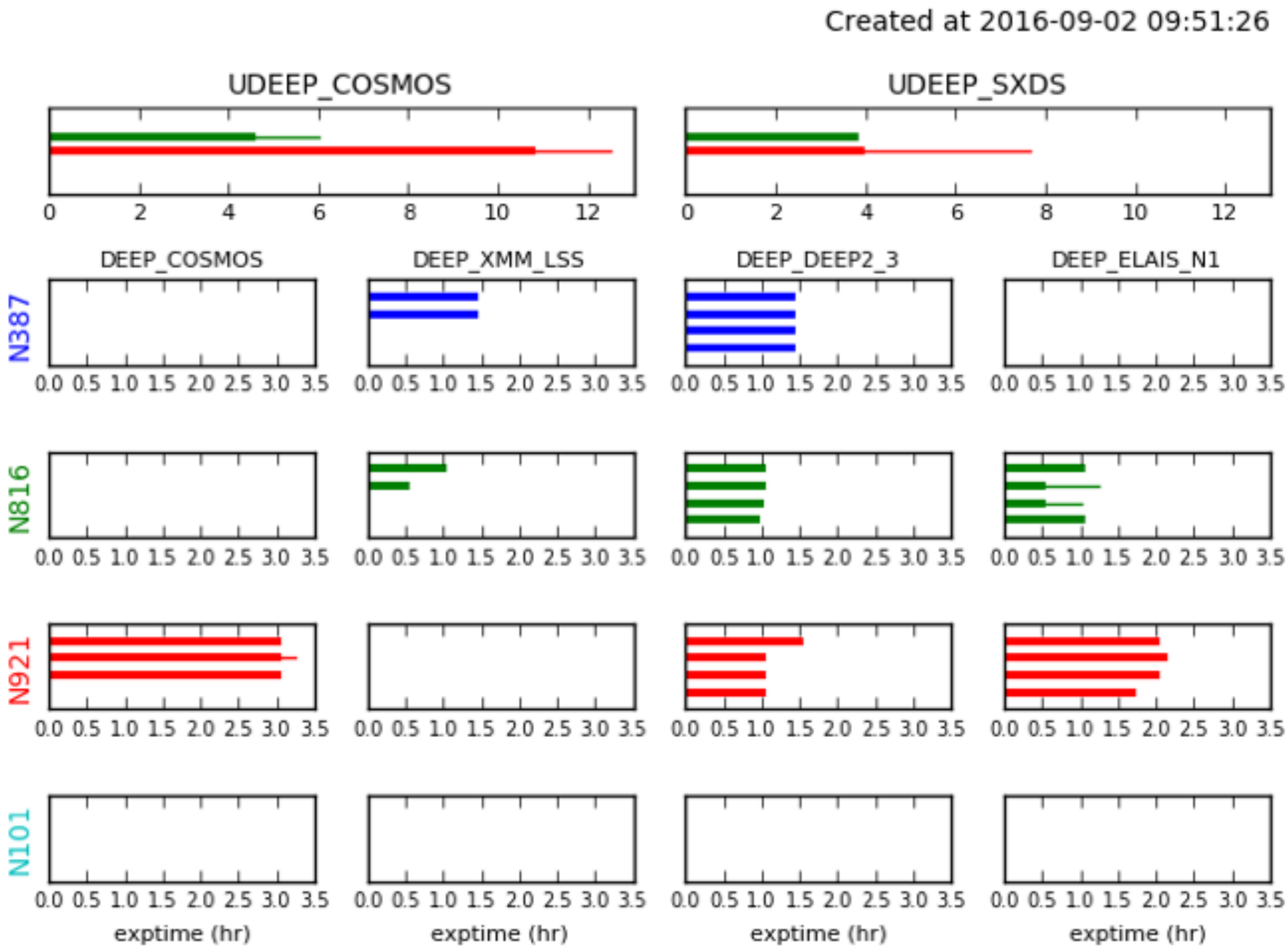
Dotted lines:

Expected observing speed to finish all Wide field pointing within 300 nights

gr : on schedule izY : ~ 80 % compete

1400 -> 1100 deg^2 by 2019E ?


Created at 2017-03-07 12:55:16
UDEEP_COSMOS
UDEEP_SXDS
DEEP_COSMOS
DEEP_XMM_LSS
DEEP_DEEP2_3
DEEP_ELAIS_N1
g
r
i
z
Y
exptime (hr)
Deep, UDeep: 1/3 ~ 1/2 completed



NB921: High z Galaxy survey in progress

Comparison

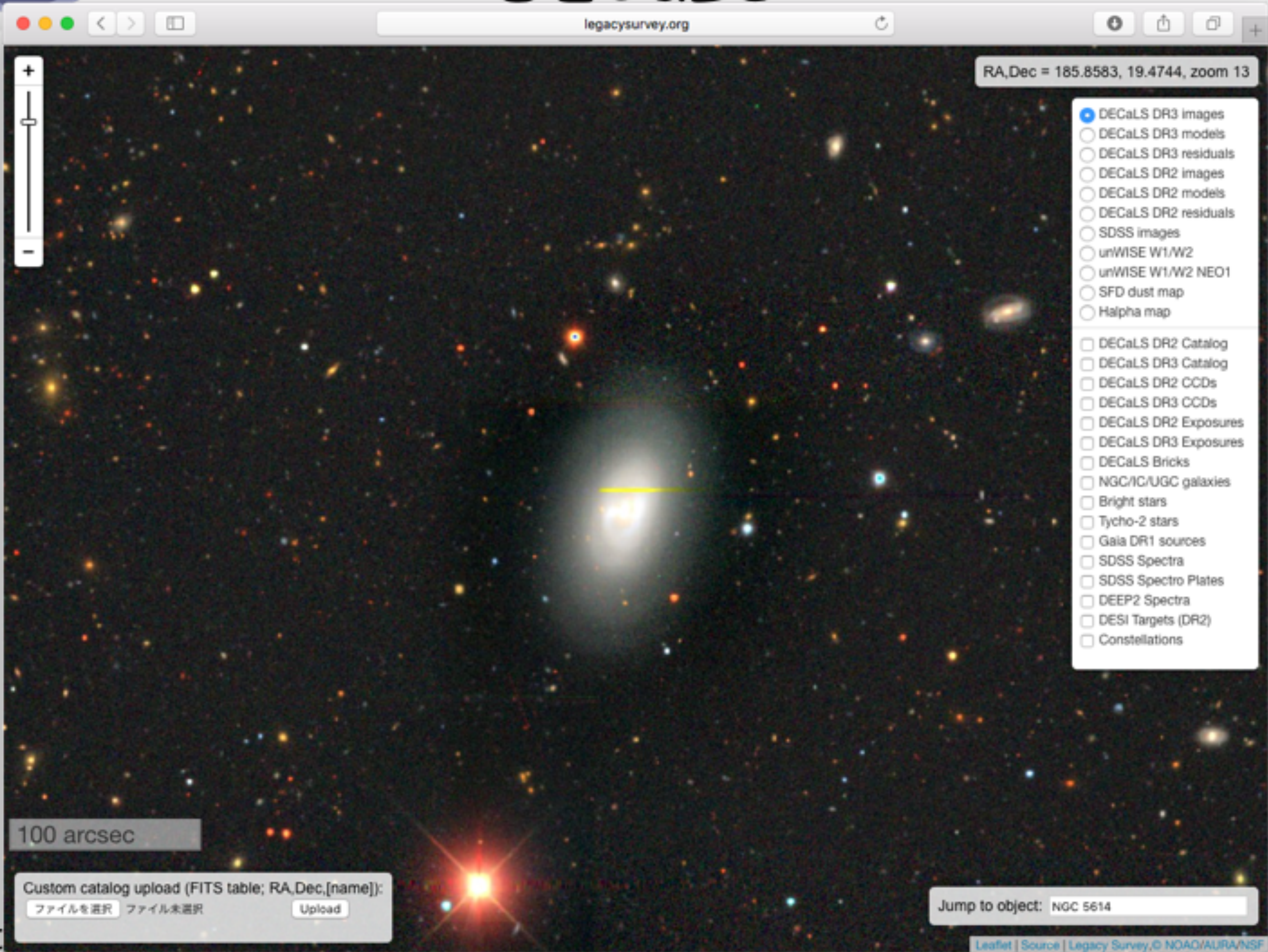
Survey	Type	Epoch	Bands	Lim. Mag.	deg^2	N/S	Seeing (arcsec)
DENIS	NIR	1997-03	iJK	$K \approx 12$	20000	South	3
SDSS	Visible	2000-05	$ugriz$	$r \approx 22.7$	14500	North	1.2
CFHT RCS2	Visible	2002-09	grz	$r \approx 24.8$	830	N+S	0.9
CFHTLS Wide	Visible	2003-12	$ugriz$	$r \approx 25$	157	North	0.9
2MASS	NIR	1997-01	JHK	$K \approx 14.3$	All sky	N+S	1.5
UKIDSS	NIR	2005-12	$YJHK$	$K \approx 18.4$	7500	North	0.9
WISE	Mid-IR	2010-12	$3.4 - 22\mu m$	$W1 \approx 17$	All Sky	N+S	6
Pan-Starrs 3π	Visible	2010-14	$grizy$	$r \approx 22.8$	30000	N+S	1.1
SkyMapper	Visible	2009-	$uvgriz$	$r \approx 22.0$	20000	South	2.5
VST ATLAS	Visible	2011-	$ugriz$	$r \approx 22.7$	4700	South	0.9
VST KiDS	Visible	2011-	$ugri$	$r \approx 24.6$	1500	South	0.7
VISTA VHS	NIR	2010-	YJK_s	$K_s \approx 18.4$	18000	South	0.7
VIKING	NIR	2010-	$zYJHK_s$	$K_s \approx 19.5$	1500	South	0.9
DES	Visible	2013-	$grizy$	$r \approx 25.0$	5000	South	0.9
DECaLS	Visible	2015-	grz	$r \approx 23.6$	9000	North	1.2
HSC Wide	Visible	2015-	$grizy$	$r \approx 26.0$	1400	South	0.7

Table 1 Recent Optical and NIR extragalactic imaging sky surveys with an area of $> 100\text{deg}^2$. Magnitude limits are quoted in r_{AB} and K_{Vega}.

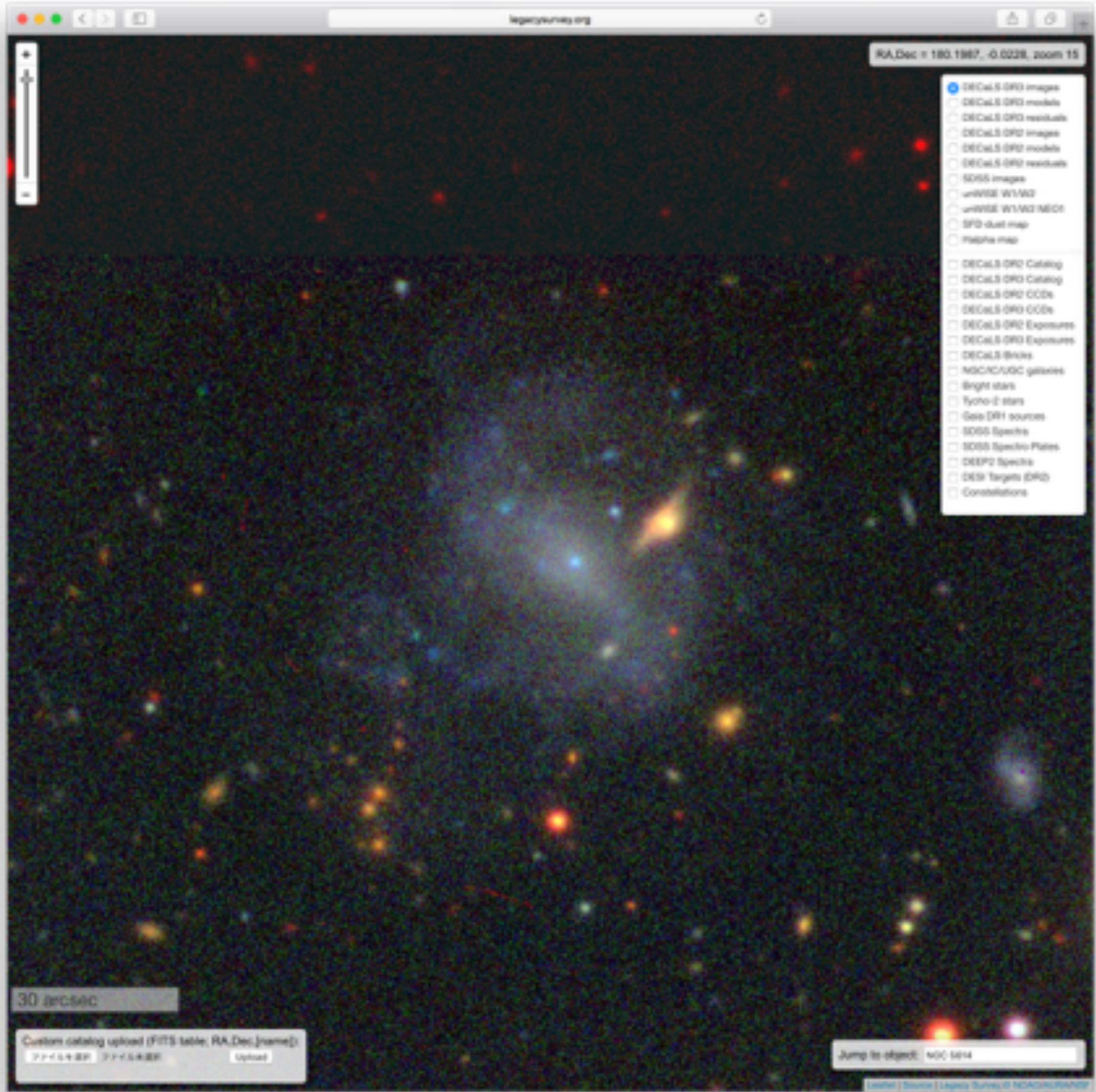
Comparison

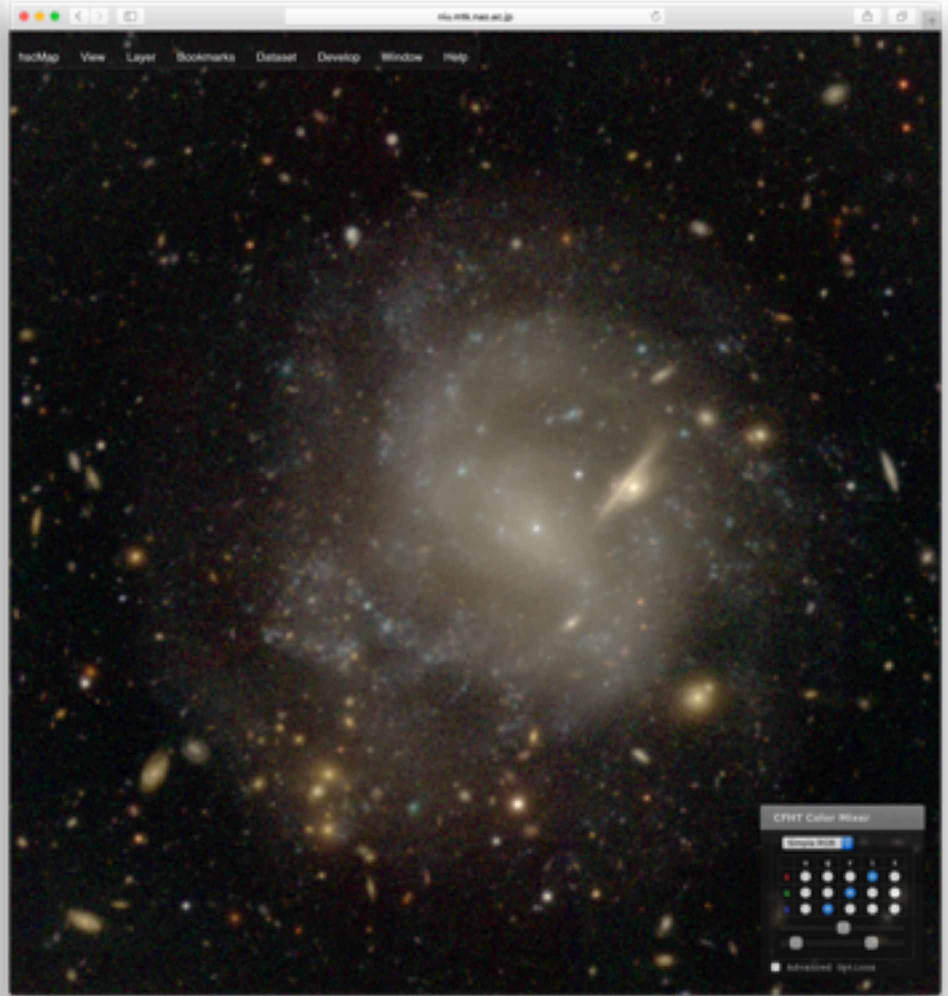
DES	Visible	2013-	*grizy*	$r \approx 25.0$	5000	South	0.9
DECaLS	Visible	2015-	*grz*	$r \approx 23.6$	9000	North	1.2
HSC Wide	Visible	~~2015-~~	*grizy*	$r \approx 26.0$	1400	~~South~~	0.7
		2014-				N/S	

DECaLS


legacysurvey.org
RA,Dec = 185.8583, 19.4744, zoom 13
DECaLS DR3 images
DECaLS DR3 models
DECaLS DR3 residuals
DECaLS DR2 images
DECaLS DR2 models
DECaLS DR2 residuals
SDSS images
unWISE W1/W2
unWISE W1/W2 NEO1
SFD dust map
Halpha map
DECaLS DR2 Catalog
DECaLS DR3 Catalog
DECaLS DR2 CCDs
DECaLS DR3 CCDs
DECaLS DR2 Exposures
DECaLS DR3 Exposures
DECaLS Bricks
NGC/IC/UGC galaxies
Bright stars
Tycho-2 stars
Gaia DR1 sources
SDSS Spectra
SDSS Spectro Plates
DEEP2 Spectra
DESI Targets (DR2)
Constellations
100 arcsec
Custom catalog upload (FITS table; RA,Dec,[name]):
ファイルを選択 ファイル未選択
Upload
Jump to object: NGC 5614
Leaflet | Source | Legacy Survey,© NOAO/AURA/NSF

Comparison

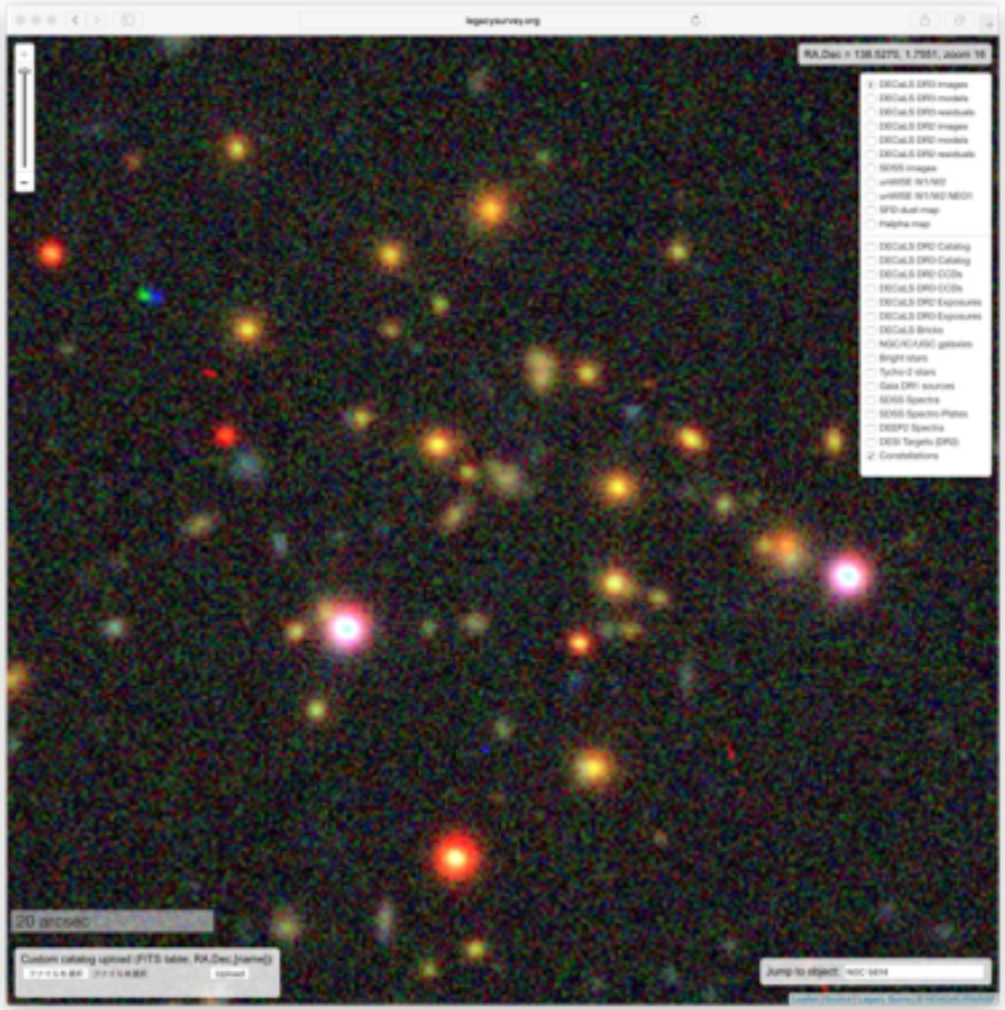


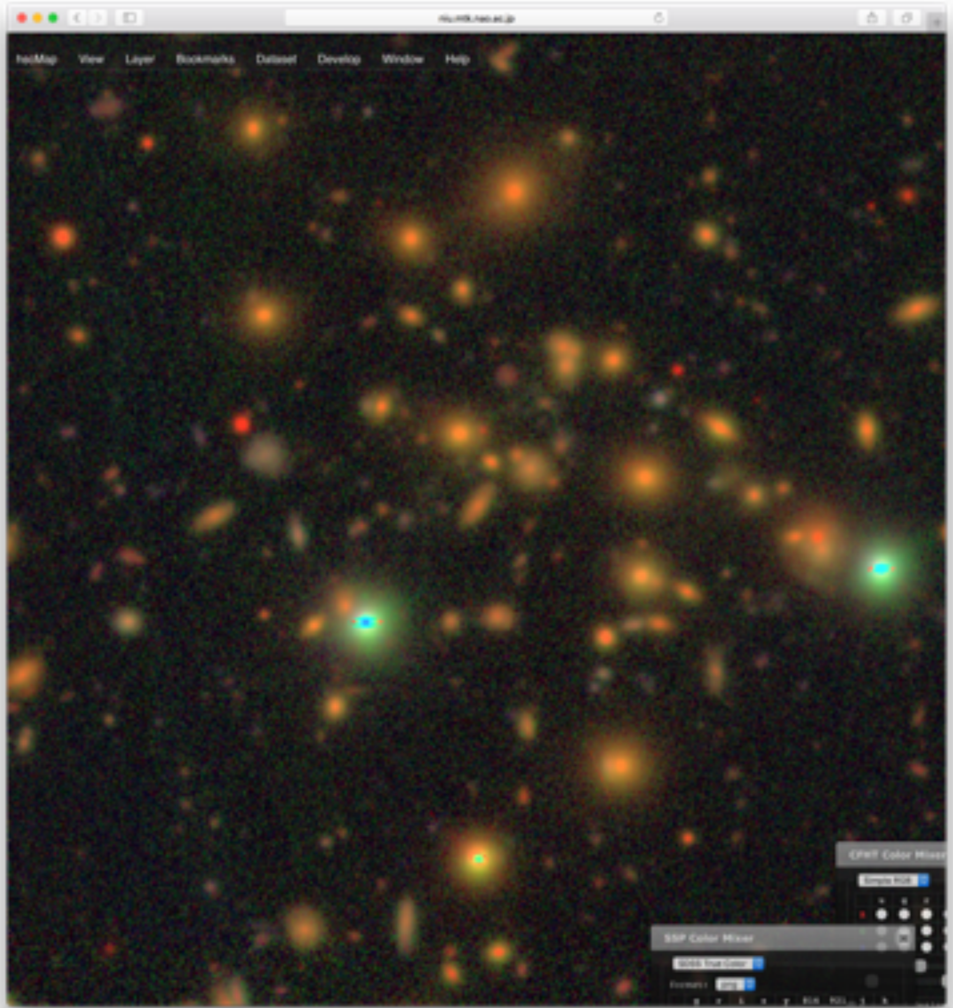


NAOJ

HSC

Comparison


20 arcsec
Jump to object:
Constellations


View
Layer
Bookmarks
Dataset
Develop
Window
Help

Survey Speed

Camera	CCD	AOmega	in operatio
DECam	BI-FD	30.0	2012
HSC	BI-FD	91.3	2012
LSST	BI-DD	347.8	(2022?)

HSC is the world leading facility until LSST comes

PASJ Special Issue

Technical papers:
  Camera: Miyazaki
  Survey Design: Takada and Strauss
  Data Release: Tanaka
  Shear Catalog: Mandelbaum
  Pipeline: Bosch
  Photo-z: Tanaka
Huang: Synpipe 1
Murata: Synpipe 2

Low-z Galaxy working group:
Andy Goulding: Morphology of AGN hosts
Johnny Greco: UDGs in groups (tentative)
Masao Hayashi   : NB-selected emission-line objects
Jean Coupon   : magnification bias up to z~2
Atsushi Nishizawa: red fraction of culster galaxies
Hung-Yu Jian   : galaxy population in clusters

High-z galaxy working group:
- Yuichi Harikane, "Galaxy-Dark Matter Halo Connection Revealed by the Subaru Hyper Suprime-Cam Survey"
- Yoshiaki Ono, "The Bright End of the Galaxy Luminosity Functions at z=4-7 based on the Subaru Hyper Suprime-Cam Survey"
- Akira Konno, "First Results of Subaru/Hyper Suprime-Cam 24deg^2 Narrowband Survey: Lya Luminosity Functions at z=5.7 and 6.6"
- Hisakazu Uchiyama, "Correlation between protoclusters and quasars at z~4"
- Jun Toshikawa, "Systematic Search of Protoclusters at z~4 in the Subaru Hyper Suprime-Cam Survey"
- Takatoshi Shibuya, "Subaru Hyper Suprime-Cam Narrow-Band Survey for Lya Emitters: Selection and Lya Properties for Lya Emitting Objects at z~6-7"
- Takatoshi Shibuya, "Optical and NIR Spectroscopic Observations for z~6-7 Very Luminous Lya Emitters Identified in the Subaru Hyper Suprime-Cam Survey"
- Masami Ouchi, "Clustering of Lya Emitters at z=~6-7 Revealed by Early Subaru Hyper Suprime-Cam Survey"
- Akio K. Inoue, "A simulation of Ly-alpha emitters in the reionization epoch for the Subaru Strategic Program with Hyper Suprime-Cam"

Strong lensing Working Group:
* SUGOHI I: Photometric and Spectroscopic Search for Strong Lenses in the HSC Survey, A. Sonnenfeld et al.
* Hunting with CHITAH: Strong-lens candidates from the first-year data of the Hyper Suprime-Cam survey (tentative) J. Chan et al.
* Joint SL and WL analysis of HSC group/cluster lenses (tentative) A. Jaelani et al.
* Mass distribution of group-scale lenses from HSC (tentative) A. More et al.

AGN working group:
- He, Akiyama et al: Clustering analysis of z~4 quasars
- Matsuoka et al: Spectroscopic identification of z~6-7 quasars (SHELLQs Paper II)
- Akiyama, He, Ikeda et al: Luminosity function of z~4 quasars
- Shirasaki, Strauss: The environment of quasars at intermediate redshifts
- Terashima: X-ray bright optically faint sources
- Onoue: Galaxy environment around multiple QSO system

Cluster working group:
** Hironao Miyatake: ACTpol xc HSC
** Elinor Medezinski: Planck xc HSC
** Miyaoka-san and Nobu: x-ray properties of selected HSC clusters
** Masamune Oguri: camira cluster sample
** Hung-Yu: on quenching of galaxies in clusters
** Yen-Ting Lin: evolution of BCG, stellar mass function, and radio galaxies in camira
** Atsushi Nishizawa: red fraction evolution
** Surhud More: splashback radius -- although this may be merged with Atsushi's paper above, still TBD

Galactic Archeology Working Group:
Halo Structure using BHB stars

Weak lensing working group:
Mandelbaum: Shear catalog
Miyatake: Cosmological constraints by CMASS/BOSS galaxy clustering and the HSC-BOSS galaxy-galaxy weak lensing measurements
Miyatake: Weak lensing measurement of ACTPol clusters
Medezinski: Weak lensing measurement of Planck clusters
Medezinski: Source selection for cluster weak lensing
Leauthaud: Comparing light profiles of massive galaxies and WL measurements with hydro sims
Speagle: Application of FRANKENZ (Josh's photoz code) to HSC and validation using g-g lensing
Mandelbaum: GREAT3-like simulations paper
Miyazaki: shear selected clusters
Oguri: Wide area mass maps in 2D and 3D
Oguri: Mass-richness relation of CAMIRA clusters

Solar System working group:
Yoshida & Terai: Jupiter trojans (to ApJ?)
Terai & Yoshida: Hilda group (to ApJ?)
Terai: Colors of known TNO's

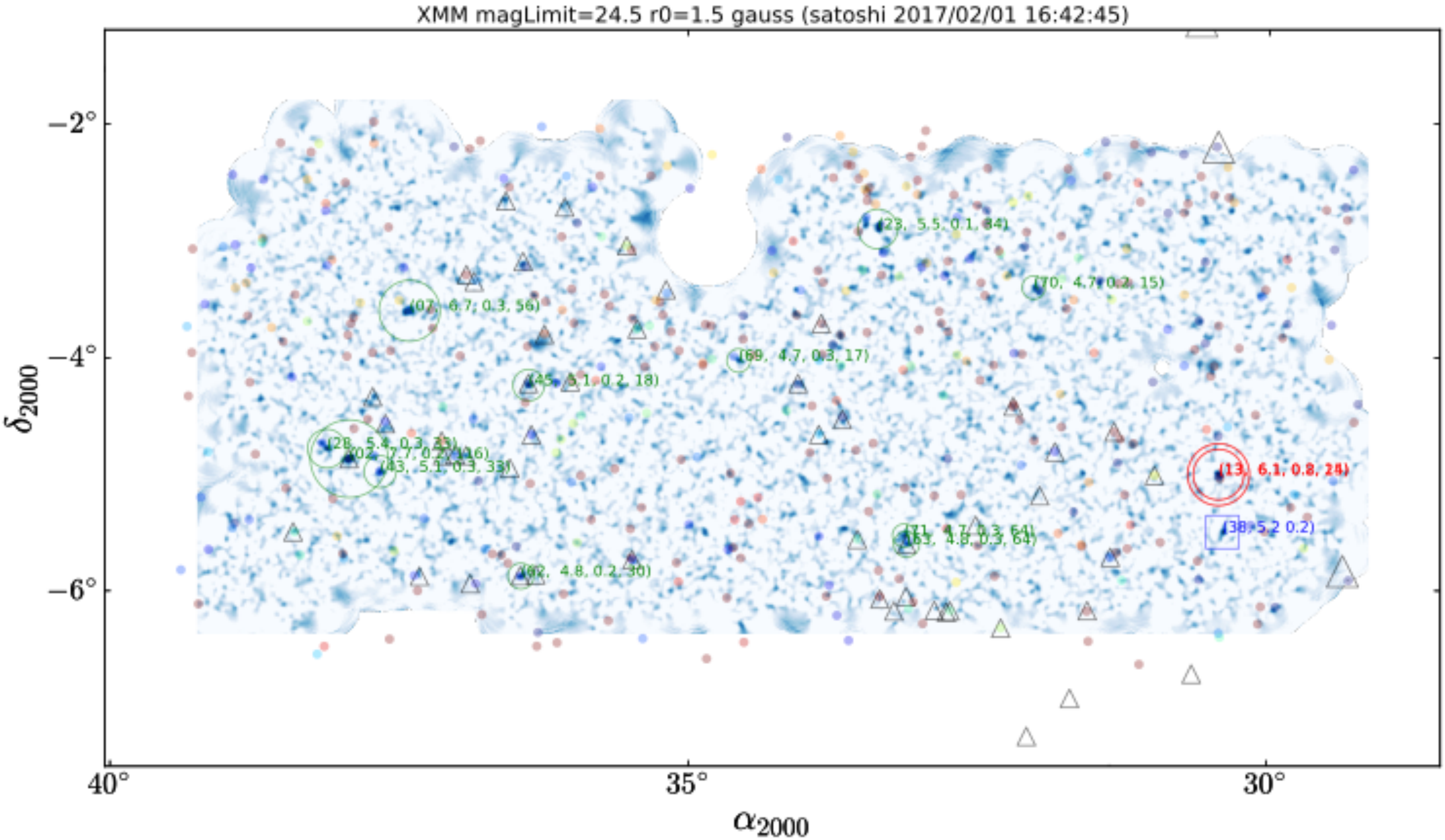
~ 40 papers planned

Public Data Release

February 2017

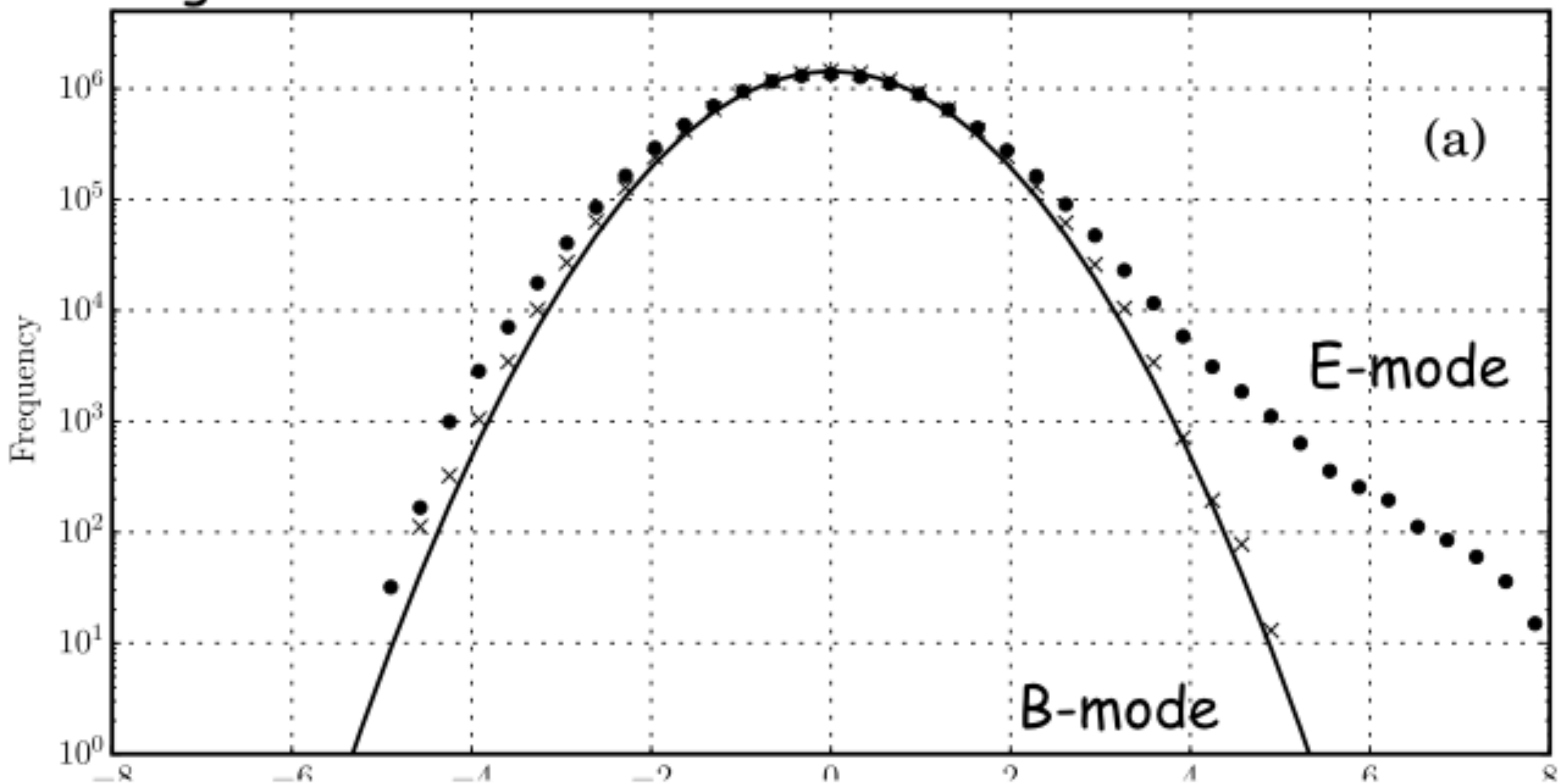
~ 100 deg^2 Full depth

Aperture Mass Map



Peaks From E/B-mode maps

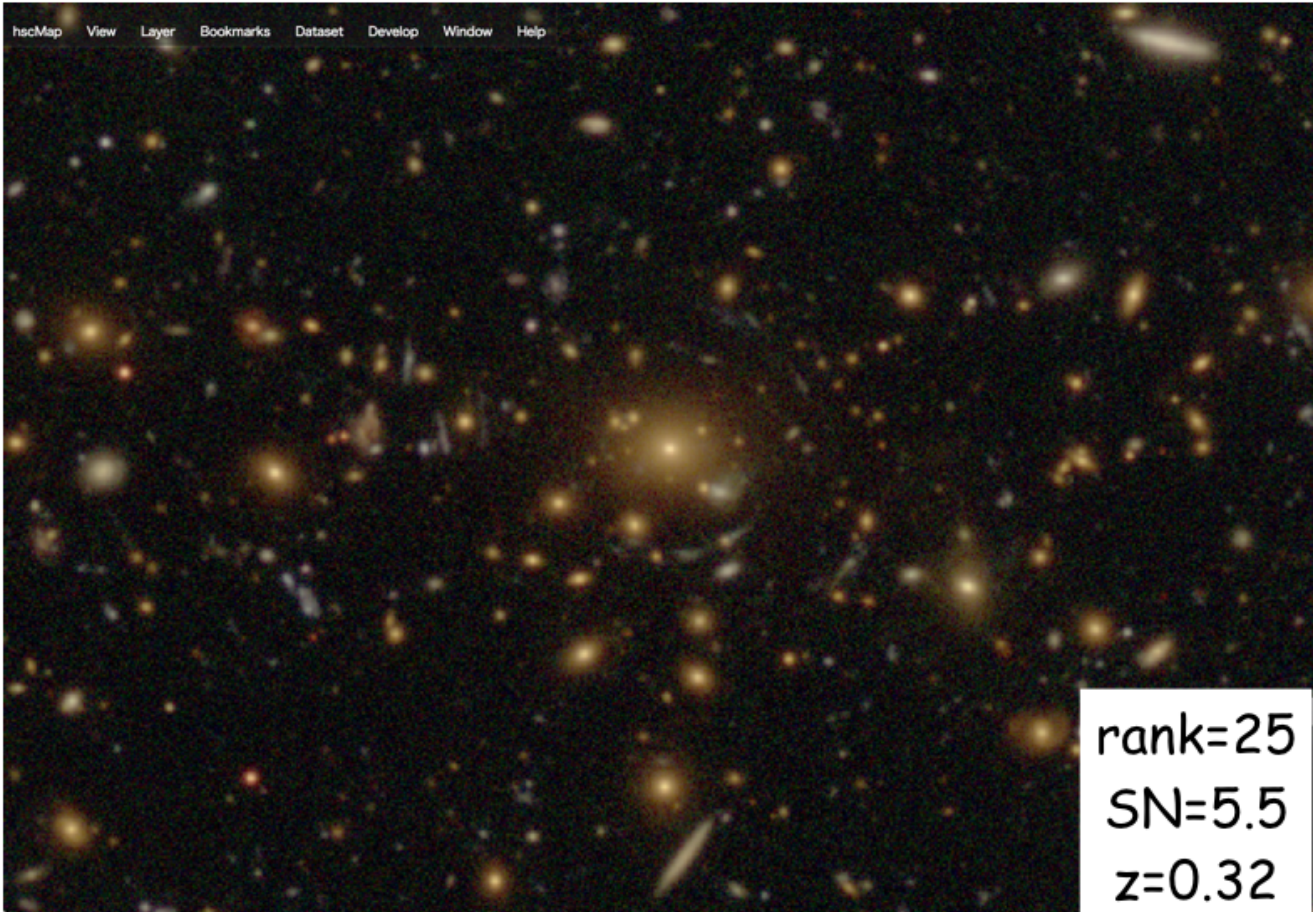
160 deg



No B-mode Peak Beyond |SN| > 5

SN > 5 Peaks on E-mode are likely to find physical counterparts

E mode: 71 Peaks (SN > 4.7)


hscMap
View
Layer
Bookmarks
Dataset
Develop
Window
Help
rank=25
SN=5.5
z=0.32

Optical Identification

SN > 4.7

< 1 arcmin (<~ 1.5 h^{-1} Mpc)

CAMIRA	
N_{match}	N_{peak}
1	50
2	8
3	2
0	11

Optical Identification

rank:21
SN=5.6

z=0.18
galaxies

Optical Identification

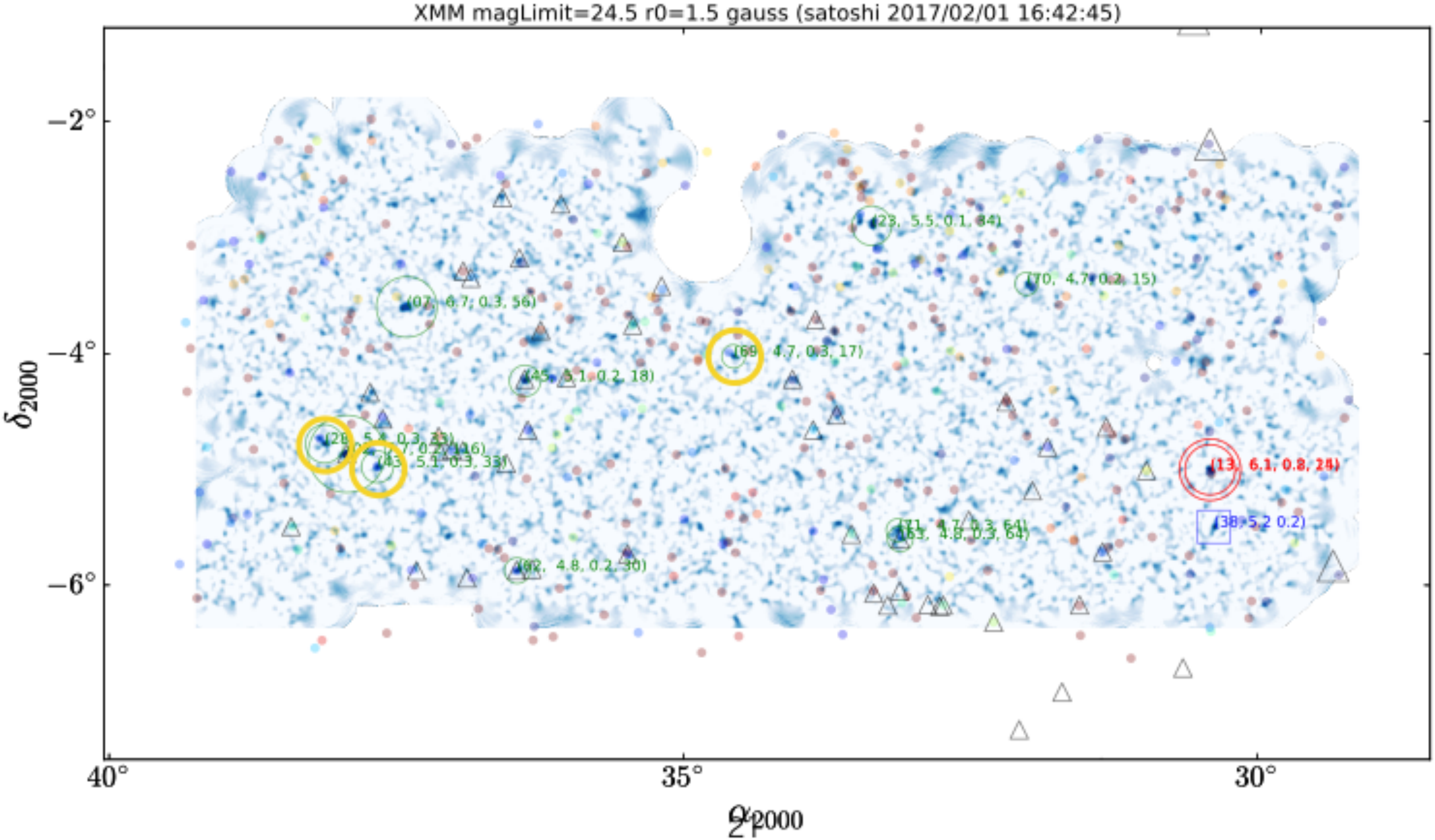
No Counterpart either on CAMIRA/WHL15: 3

SN > 5 : rank 21 — z=0.18 cluster

SN < 4.8 : rank 60, 66 — False Positive

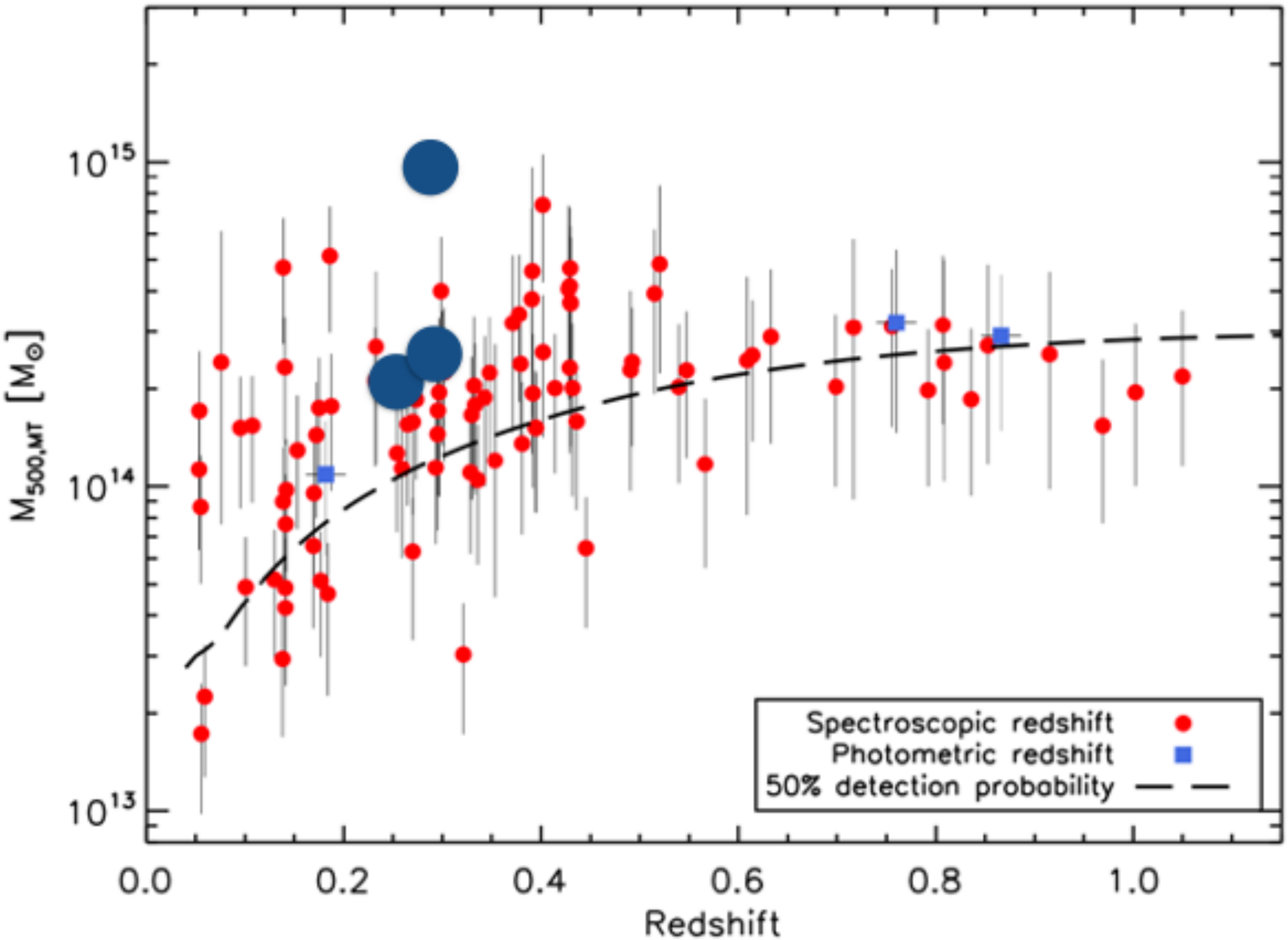
X-ray Counterparts

XXL Brightest 100 (Pacaud et al. 2015)



X-ray Counterparts

XXL Brightest 100 (Pacaud et al. 2015)



For Early Years Science

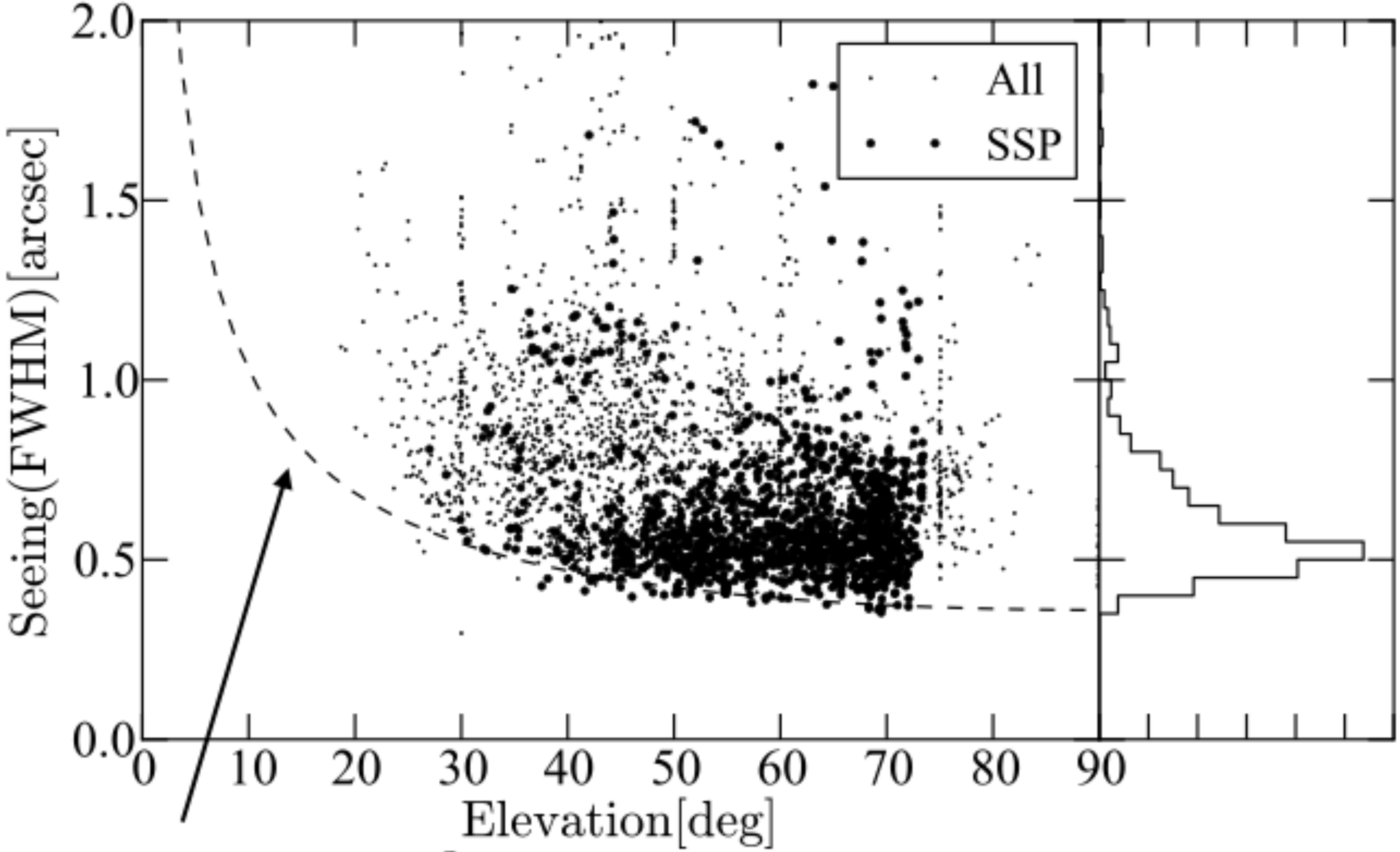
Statistics is poor due to the limited data.

Necessary accuracy in PSF correction is looser in lensing analysis.

For the final data set

More careful understanding of the system and the origin of the PSF is crucial to improve the PSF correction algorithm.

Understanding of PSF



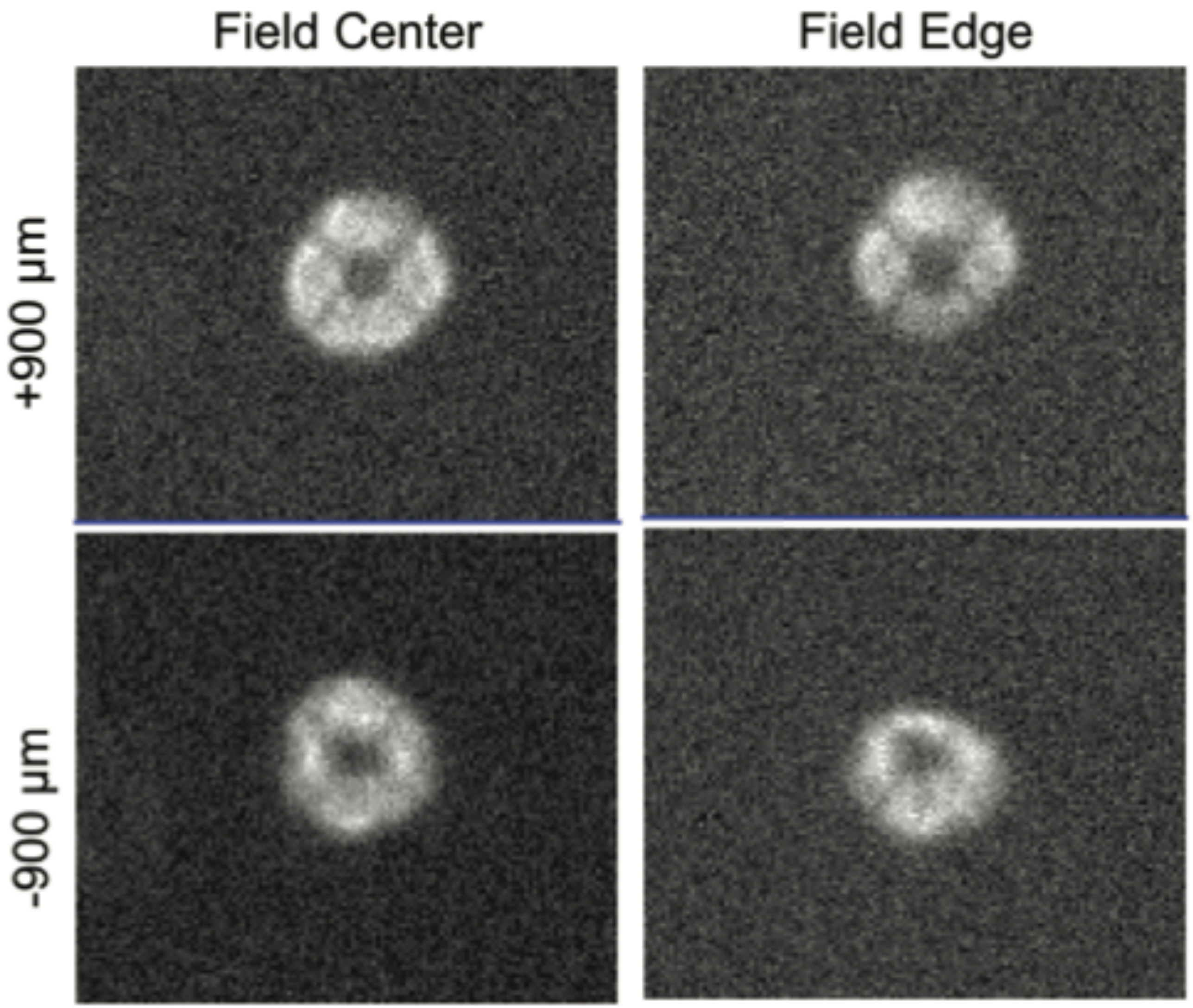
$$0.36 \times \cos^{-\frac{3}{5}}(90 - El)$$

Understanding of PSF

Imge Error budget distribution of HSC in i-band (Elevation >30 degree).

FWHM ($''$)	Error Components	FWHM ($''$)	Details	FWHM ($''$)
0.368	Diffraction	0.036		
	WFC / ADC	0.200	Optics aberration	0.200
			ADC drive error	0.014
	Primary mirror	0.100		
	Collimation	0.112	WFC displacement/tilt	0.057
			InR axis displacement	0.015
			CCD tilt	0.083
			CCD defocus	0.047
	Tracking	0.152	SP drive smoothness	0.005
			InR axial runout	0.063
			InR angle drive error	0.068
			Telescope mount	0.120
	Dewar internal flexure	0.049	CCD tilt	0.043
			CCD displacement	0.009
			CCD defocus	0.009
			Flexure variation	0.019
	CCD co-planarity	0.095		
	CCD charge diffusion	0.178		
	Filter paralelism	0.050		
	Window paralelism	0.050		

Understanding of PSF



$$\hat{I}(x,y) = \left| \mathcal{F}\left\{ \exp\left(\frac{2\pi i}{\lambda} \sum_{i=2}^{11} \hat{a}_i Z_i(u,v) \right) \right\} \right|^2$$

$$\Delta a_i = a_i - \hat{a}_i,$$

Deviation from the perfectly aligned (designed) optics by comparing obs. and calc.

Understanding of PSF

Defocus Map

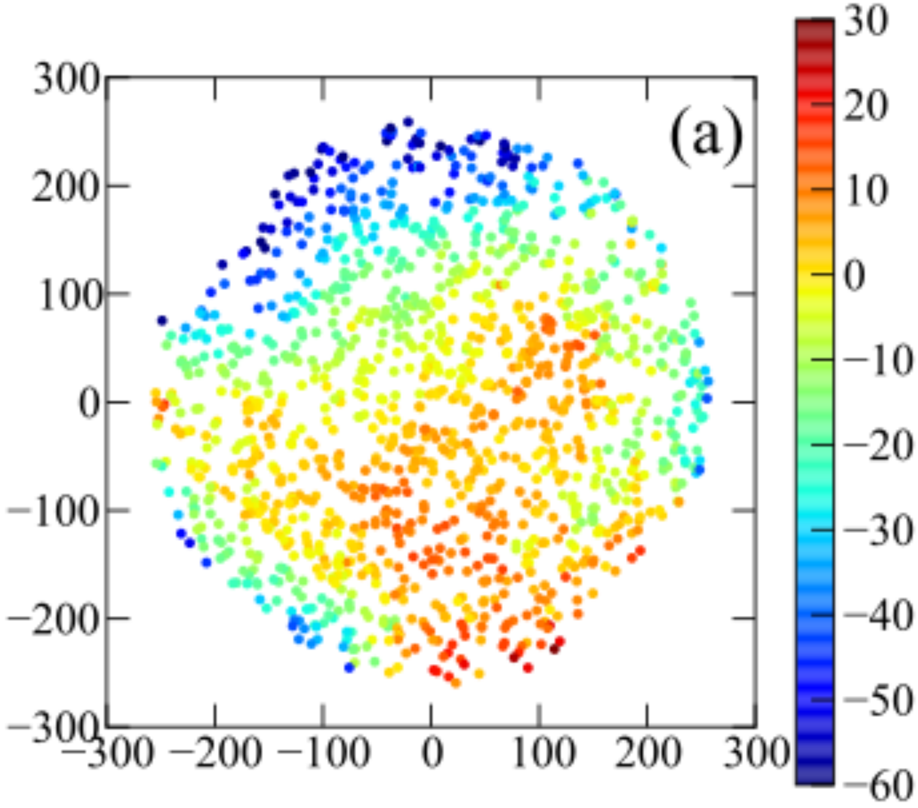
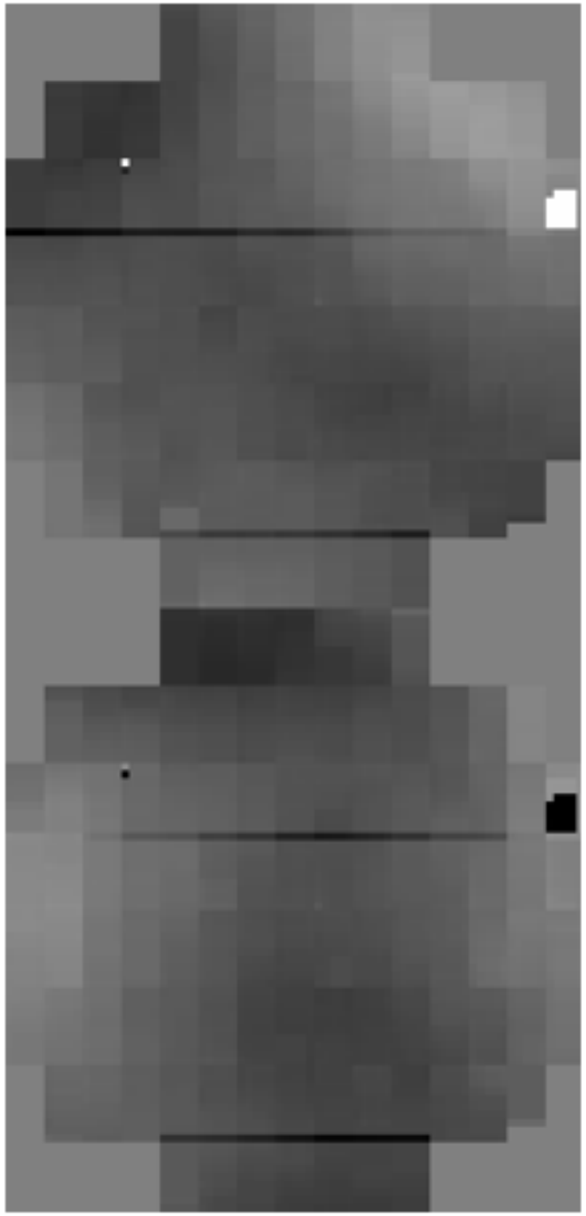


Fig. 17. Defocus (Δa_4) map in [μm]

$$\Delta a_4(x,y) = \Delta_4 + \Theta_4^x y + \Theta_4^y x,$$

PSF Evaluation

e1

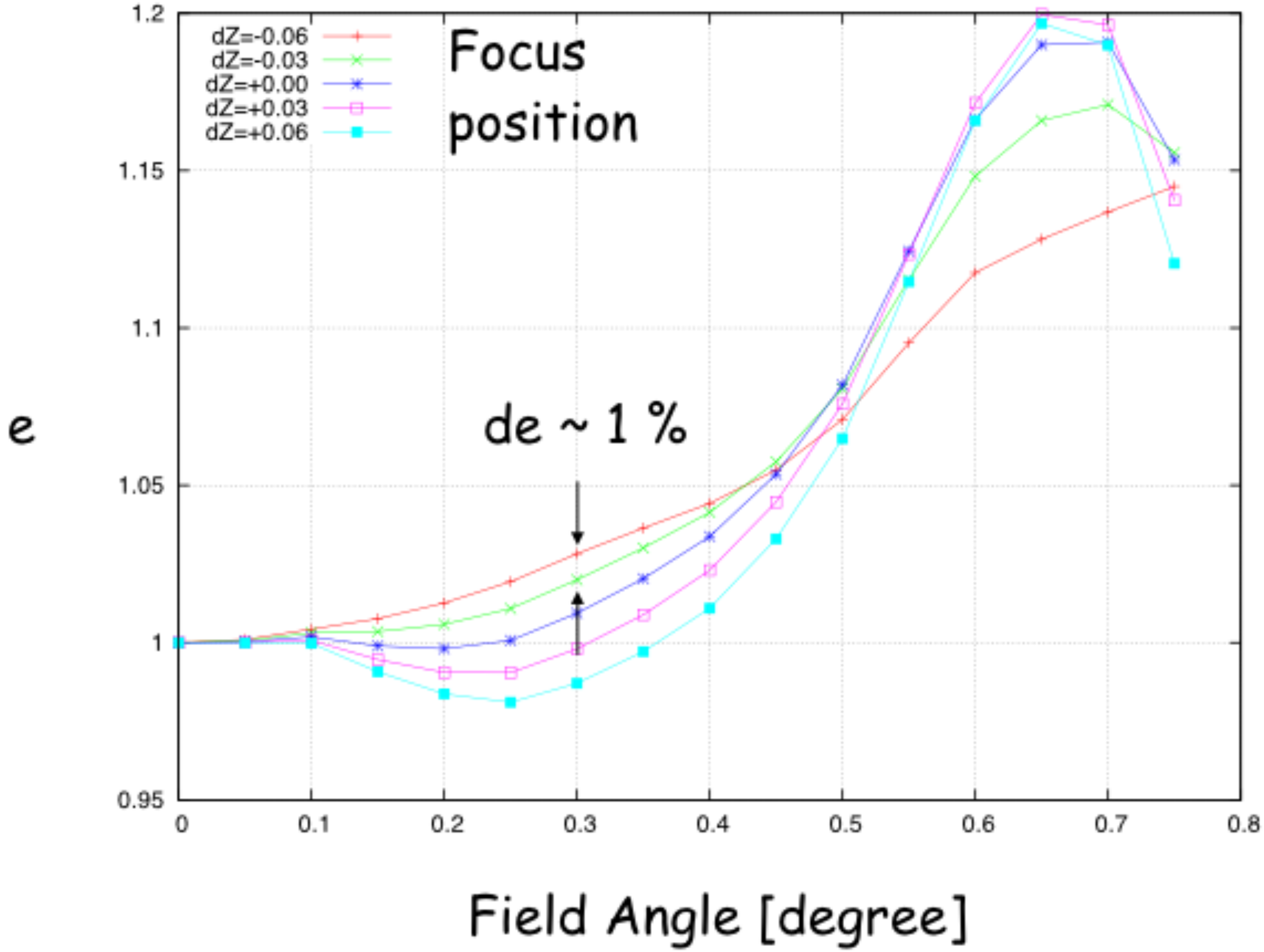


e2

~ 1 % ellipticity jump across the CCD boundary (sometimes >~ 1 %)

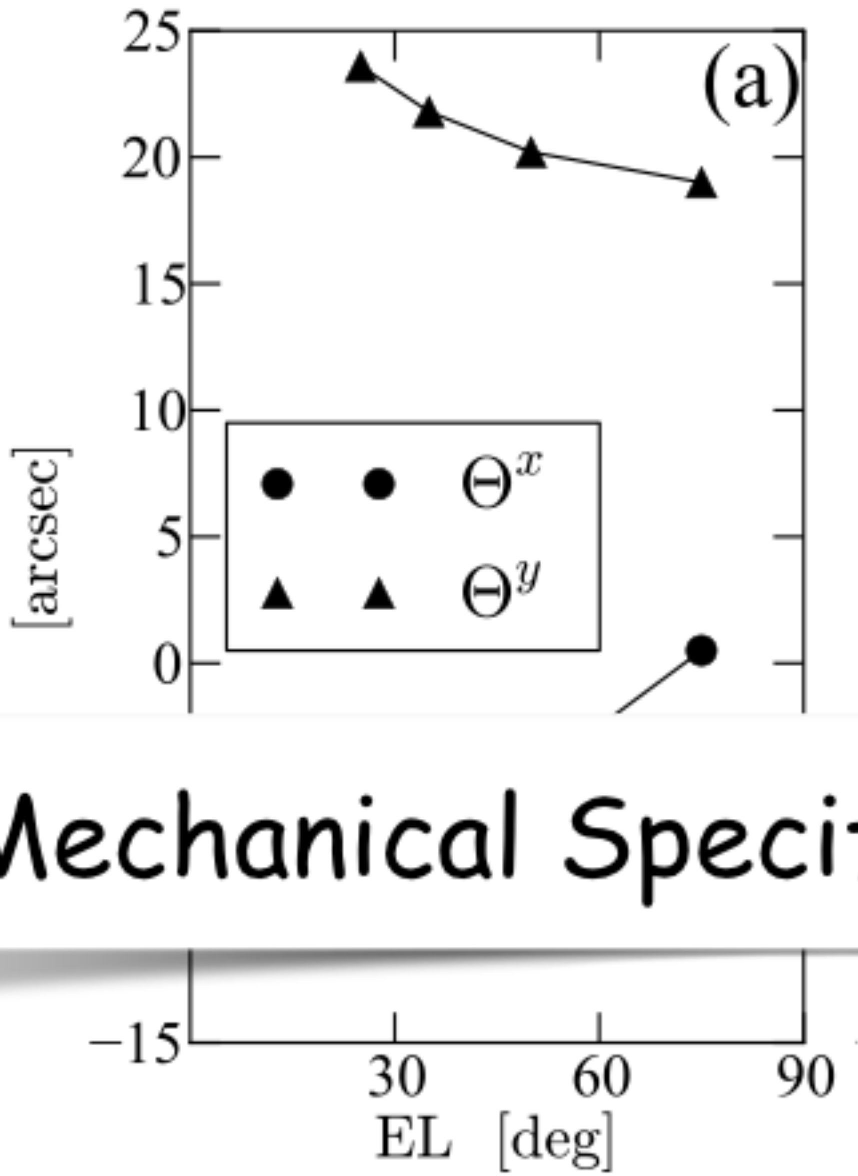
Impact of CCD height discontinuity

under 0".6 arcsec Seeing



Height Jump max ~ 30 μm

Understanding of PSF



Mechanical Specification Satisfied

15 arcsec tilt

p-v 20 arcsec tilt

Understanding of PSF

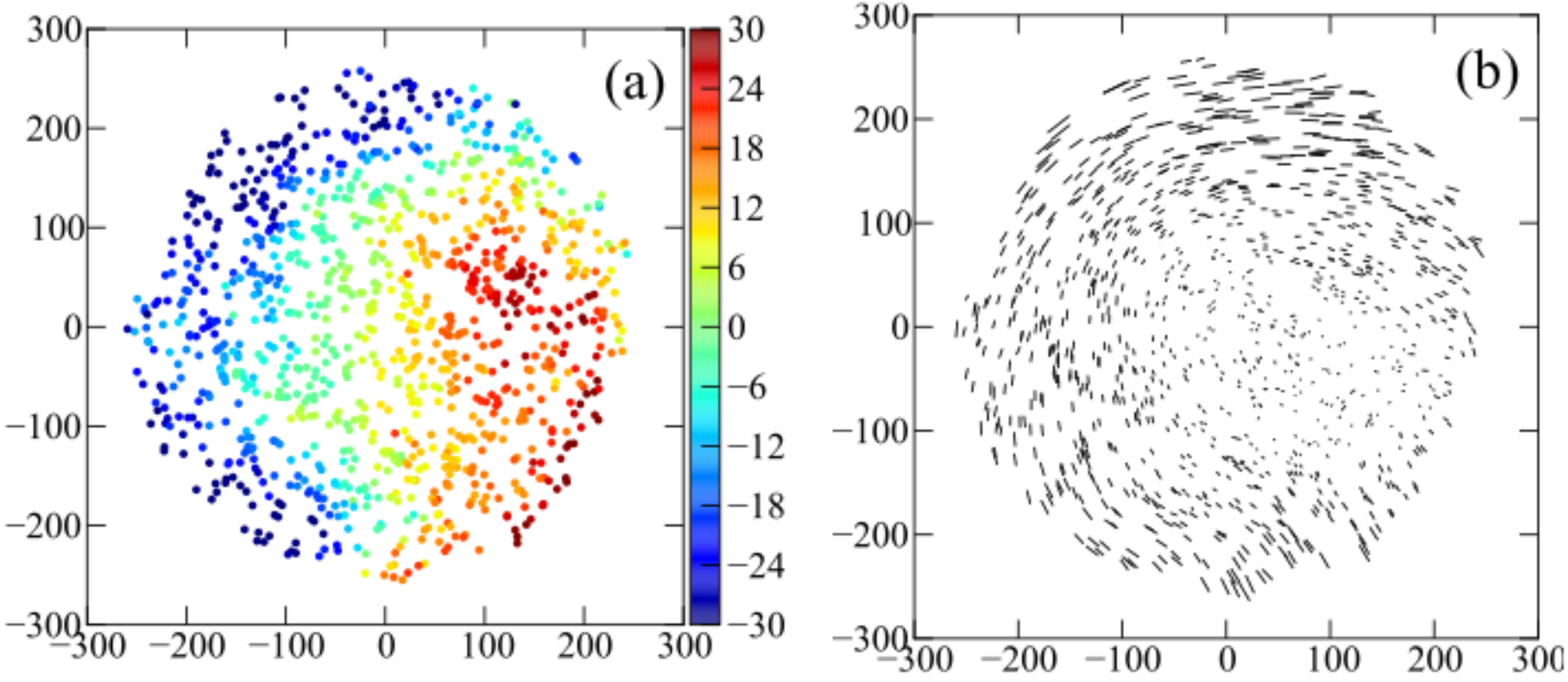
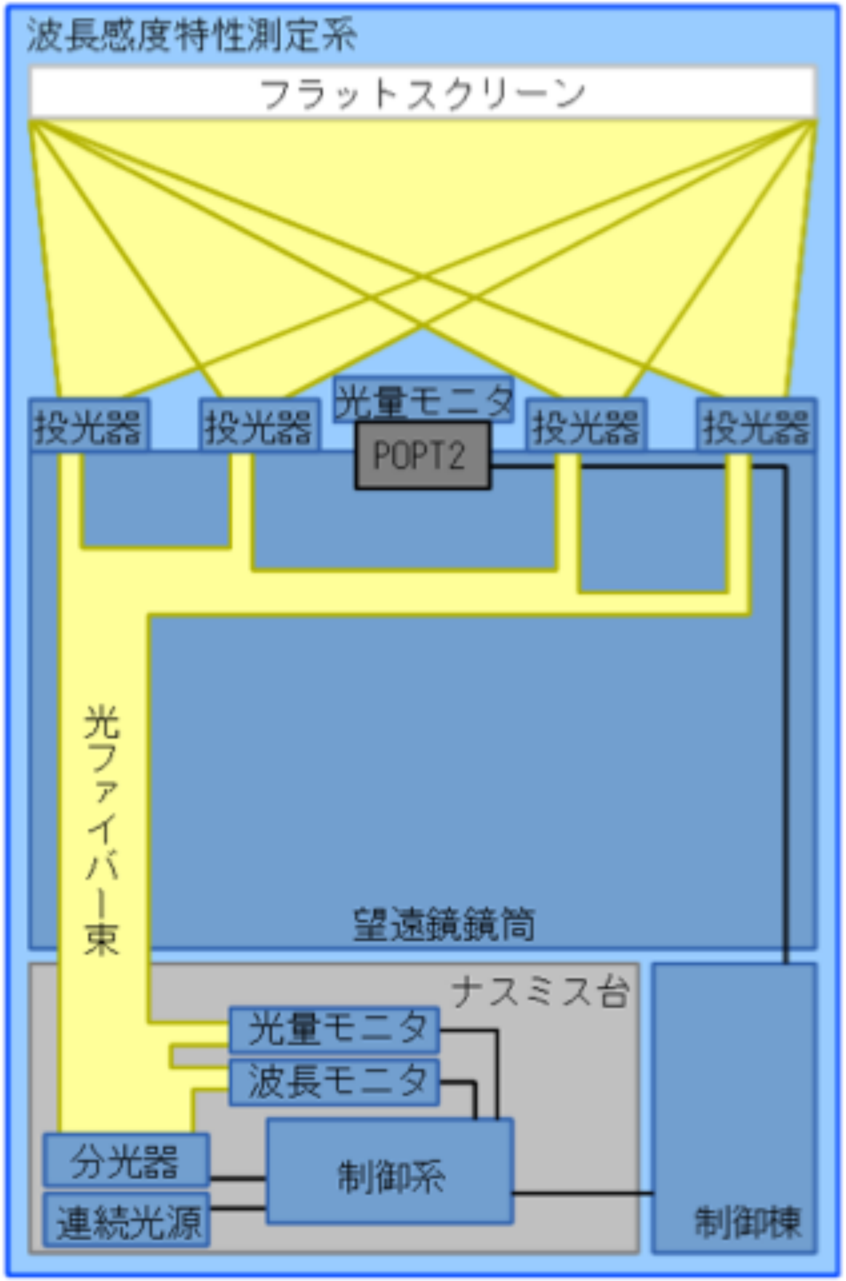
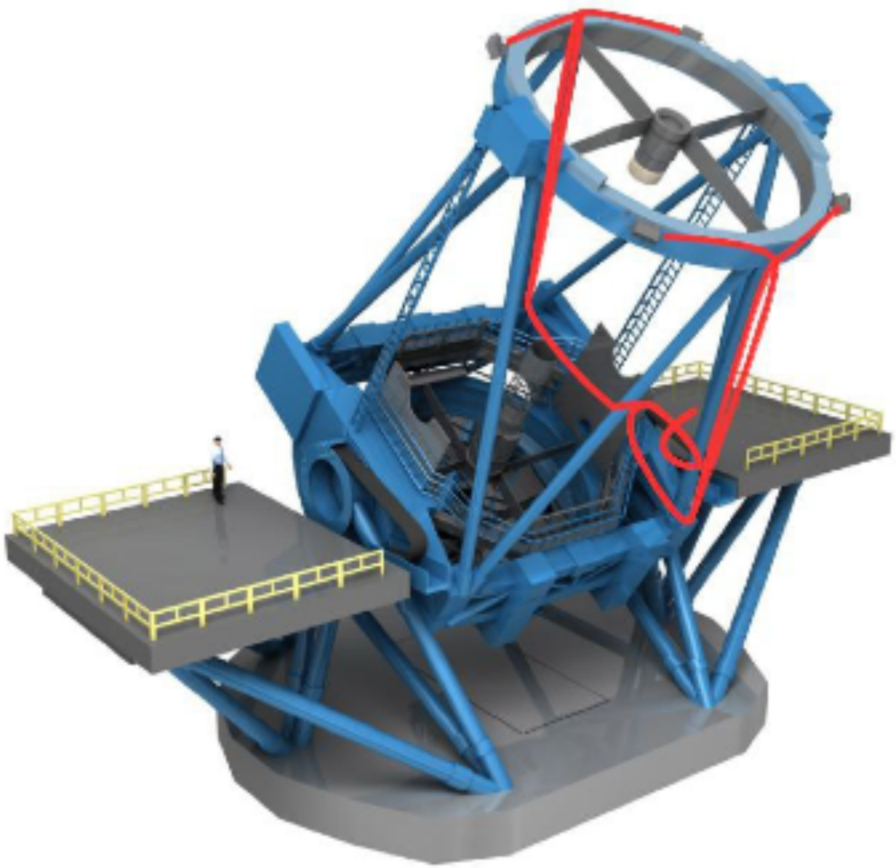


Fig. 19. Defocus (Δa_4) map (a) and astigmatism map ($\Delta a_5, \Delta a_6$)

Consistent tilt estimate obtained from a5/a6

Throughput Monitor





Throughput Monitor

Ready for Installation
but delayed due to the M1
coating rescheduled…
Should be ON this fall.

Calibration Process

1. Measure the point brightness of the screen using the photometer on the ceiling of HSC.
2. Using the on-axis pin hole, measure the spatial variation of the brightness.
3. Comparison of a flat image and (1), (2) yields the throughput of M1-WFC-FILTER-CCD system. (takes 2-3 min to have 10,000 e image in *g*)
4. Scan over the wavelength (Width 5 nm, Step 2.5nm)

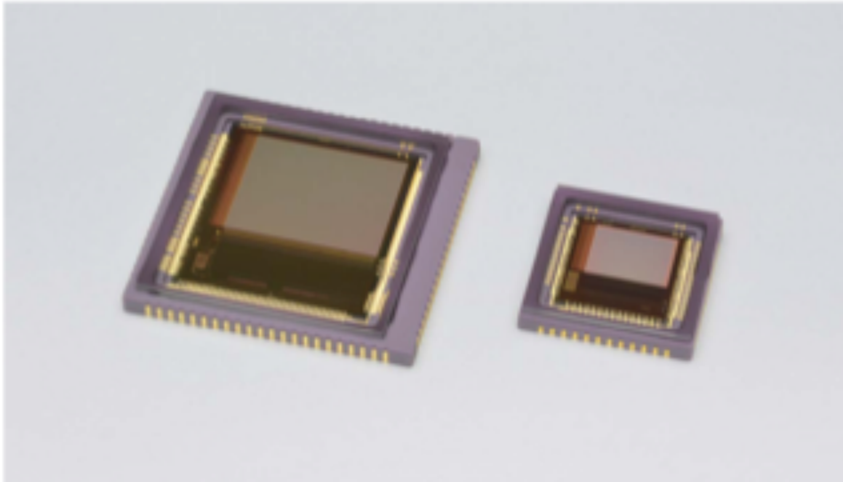
new CMOS

- Collaboration with Hamamatsu Photonics
- Evaluation of GPixel's CMOS
- Development of the Readout system

HPK CMOS

CMOSエリアイメージセンサ

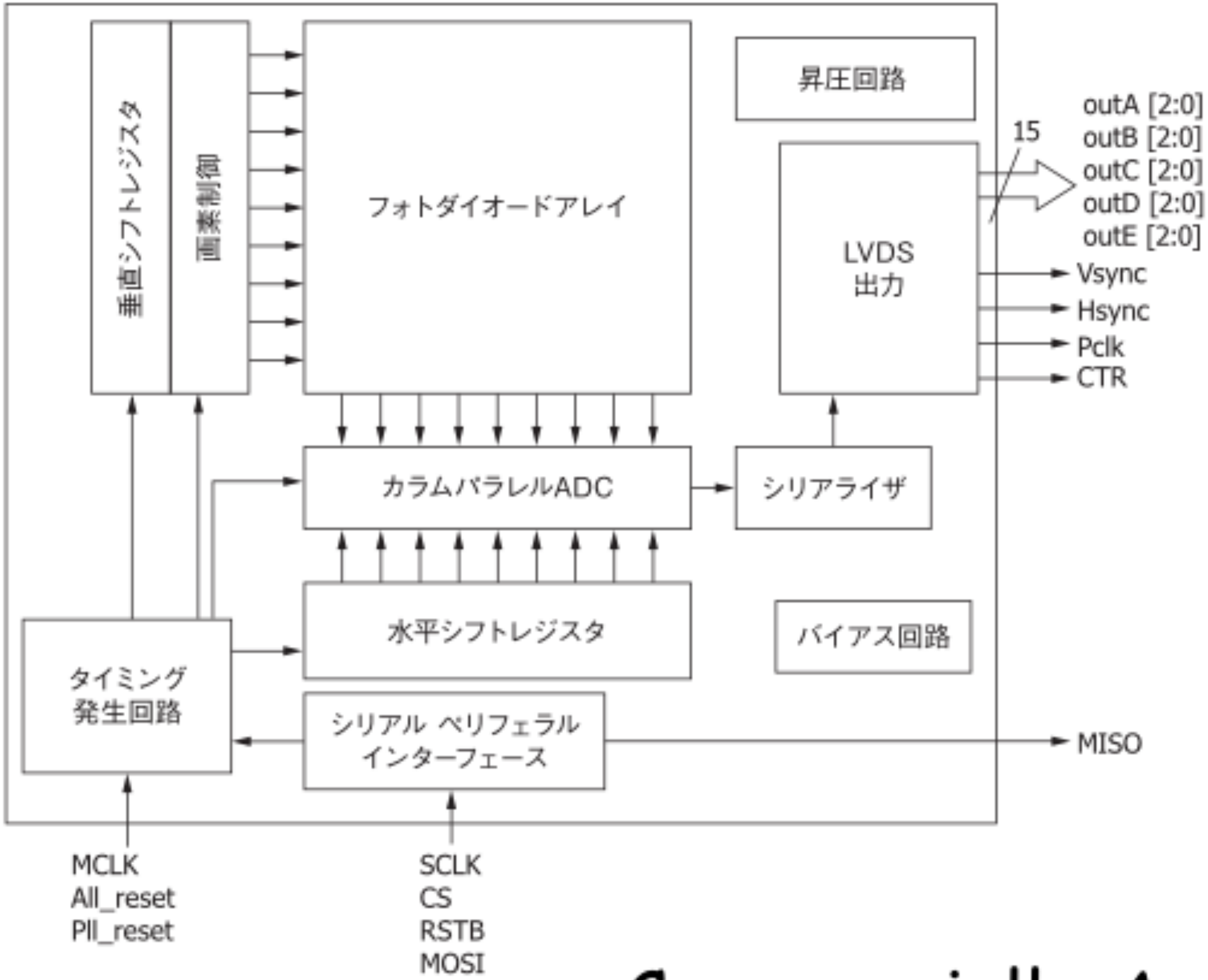
近赤外に高い感度をもつ APS (Active Pixel Sensor)タイプのCMOS エリアイメージセンサです。タイミング発生回路、バイアス発生回路、アンプ、A/D変換器を内蔵しており、オールデジタル入出力のため取り扱いが容易です。



型名	画素サイズ [μm (H) × μm (V)]	有効画素数	フレームレート (フレーム/s)	パッケージ	写真	専用駆動回路
NEW S13101	7.4 × 7.4	1280 × 1024	146	セラミック		—
NEW S13102	7.4 × 7.4	640 × 480	78	セラミック		—

Commercially Available

HPK CMOS

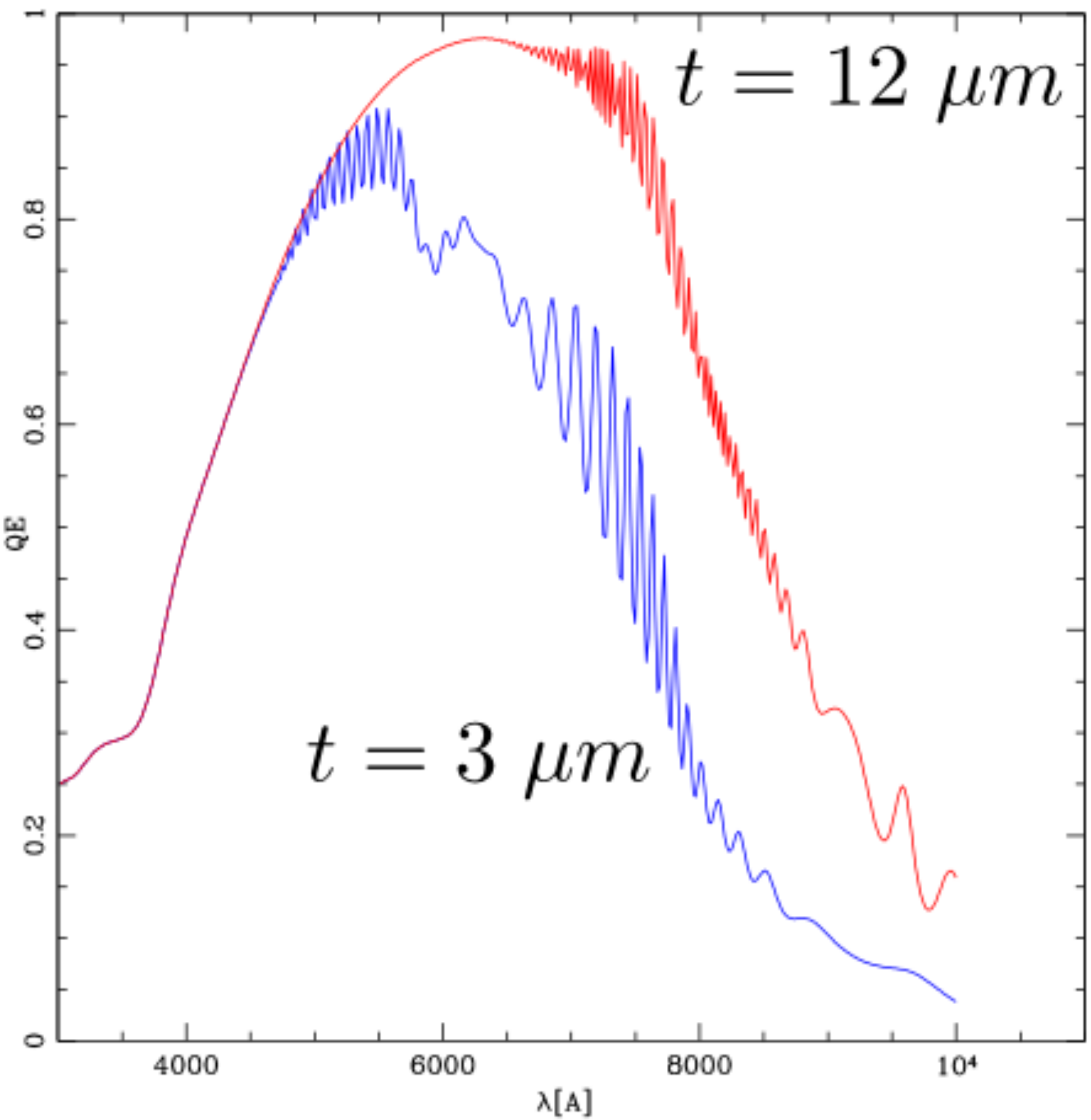


Commercially Available

HPK

- QE
  - Back Illuminated Type: in progress
  - Thicker Si up to 10 - 15 um: in progress

Expected QE

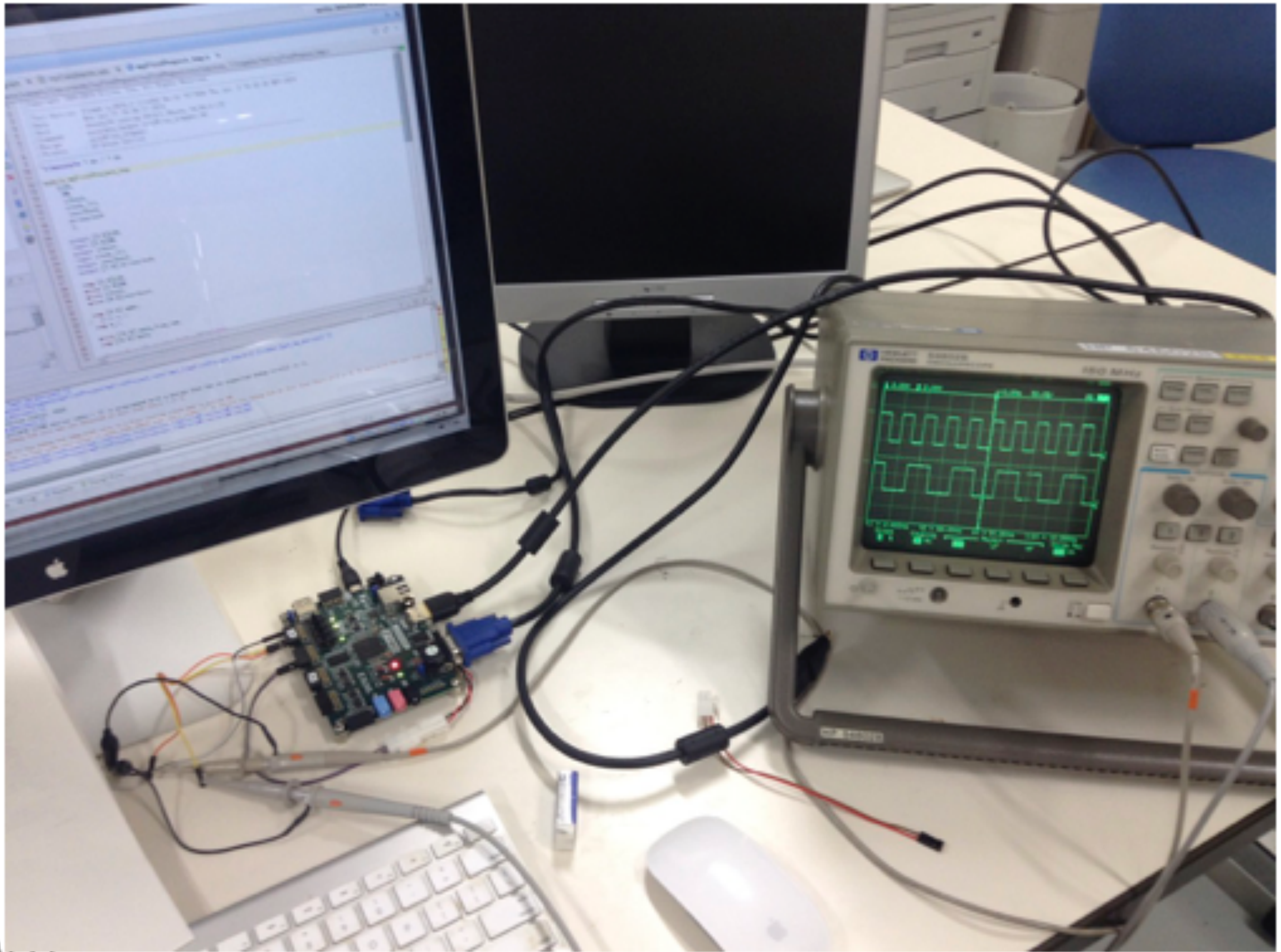


HPK

- Format
  - 1280 x 1024 (7.5 um) -> *Goal*: 8192 x 4096 (7.5 um)
    - Feasible by stitching if *gap* allows

CMOS Readout System

- Based on Zynq SOC
  - CPU + ASIC



Suggested by KEK Tanaka&Uchida

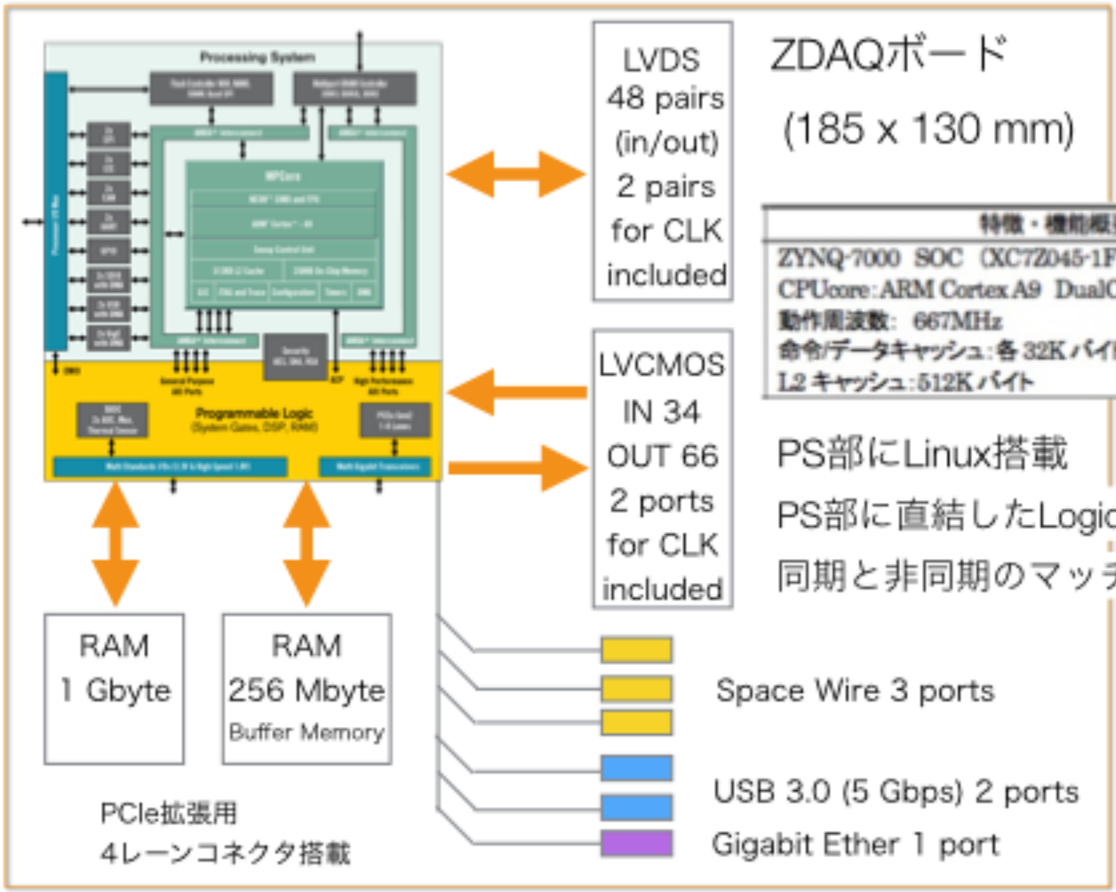
Fast PIO

Drive clock generation and data readout

CMOS Readout System

- Collaboration with ISAS/Takahashi group and NAOJ/Solar group

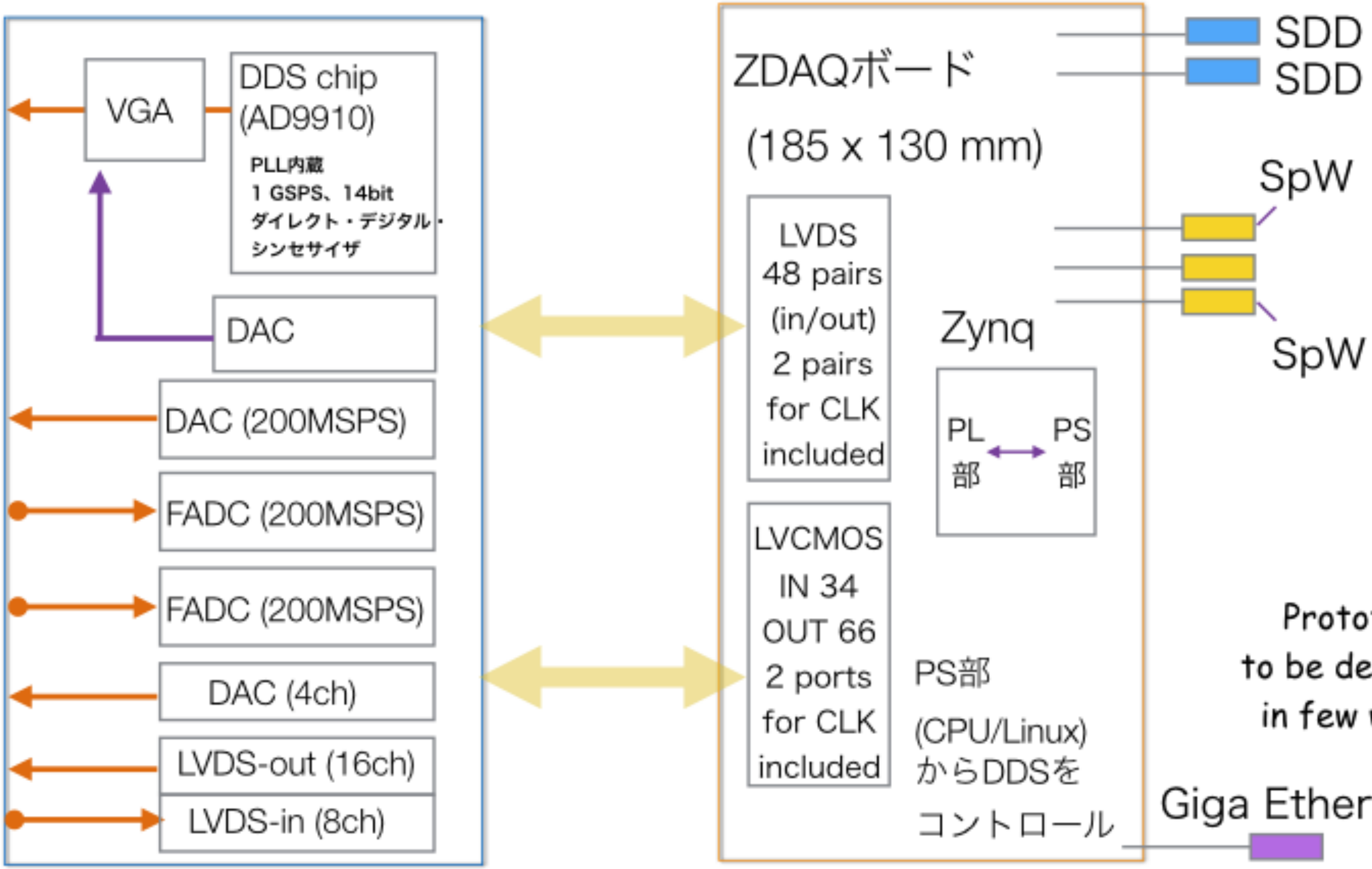
ネットワーク型高速DAQモジュール



特徴・機能概要
ZYNQ-7000 SOC (XC7Z045-1FFG900)
CPUcore:ARM Cortex A9 DualCore With NEON
動作周波数: 667MHz
命令/データキャッシュ:各 32K バイト
L2 キャッシュ:512K バイト

CMOS Readout System

ZDAQ-Analog ボード（ZDAQのDaughterボード）



Prototype
to be delivered
in few weeks