Progress of HSC-SSP Project

Satoshi MIYAZAKI

NAOJ

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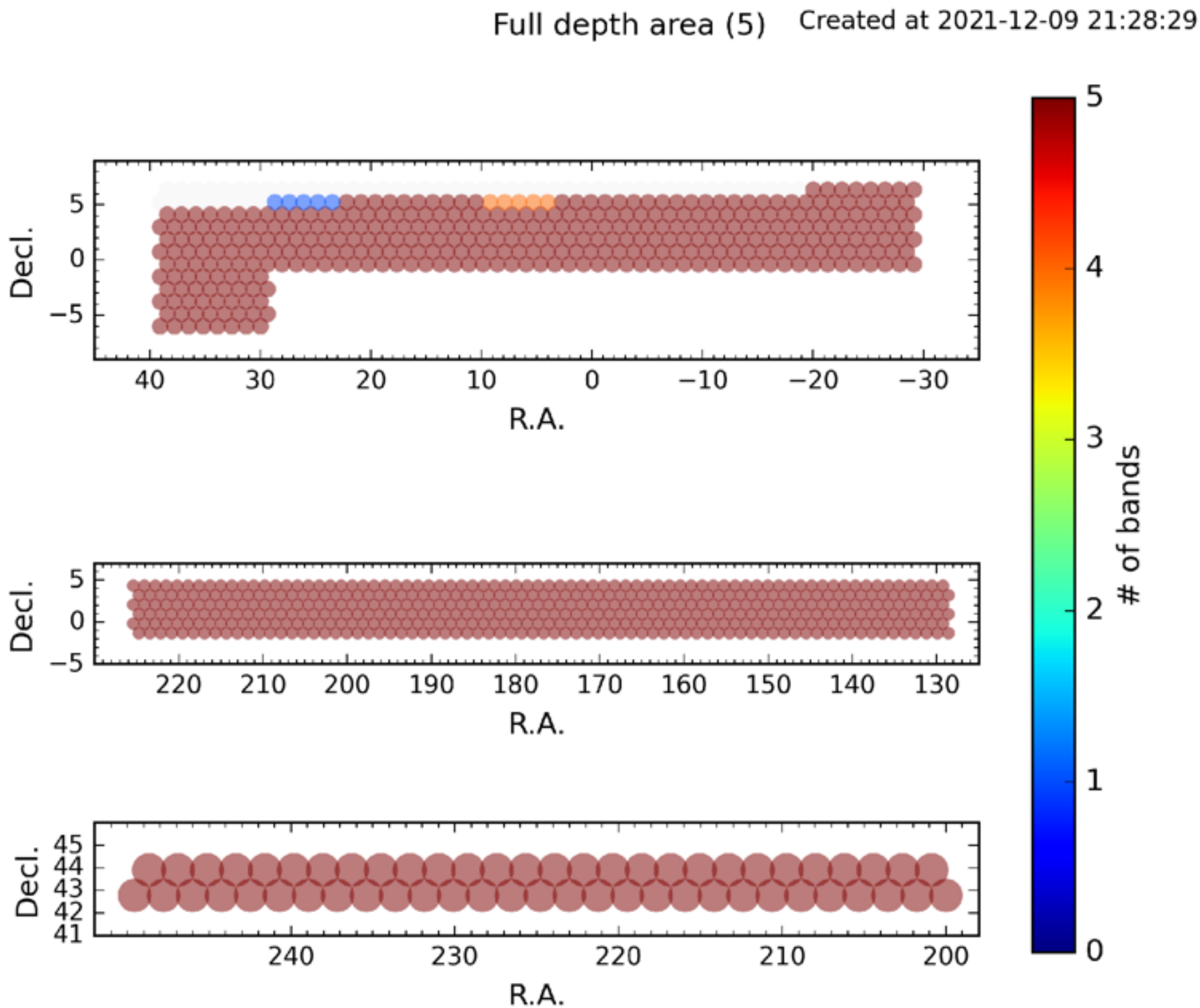
HSC-SSP

- On March, 2014, HSC-SSP started and the last observing night was 2022/01/03 (HST).
- Long-long 300 + 30 nights observations have been successfully completed thanks to the tremendous efforts made by observatory's scientists and staff members. We really appreciate their continuous collaboration.

SSP Wide



full-depth full-color 1086.8 deg2

安田氏作成

Level of Achievement

	Proposal	Actual
Observing [nights]	300	330
Wide Area [deg2]	1400	~ 1100
CoI [person]	~ 200	~ 500
International Collaboration	-	eROSITA Euclid Rubin Roman
Cosmology	A	B
Galaxy Evolution	C	D

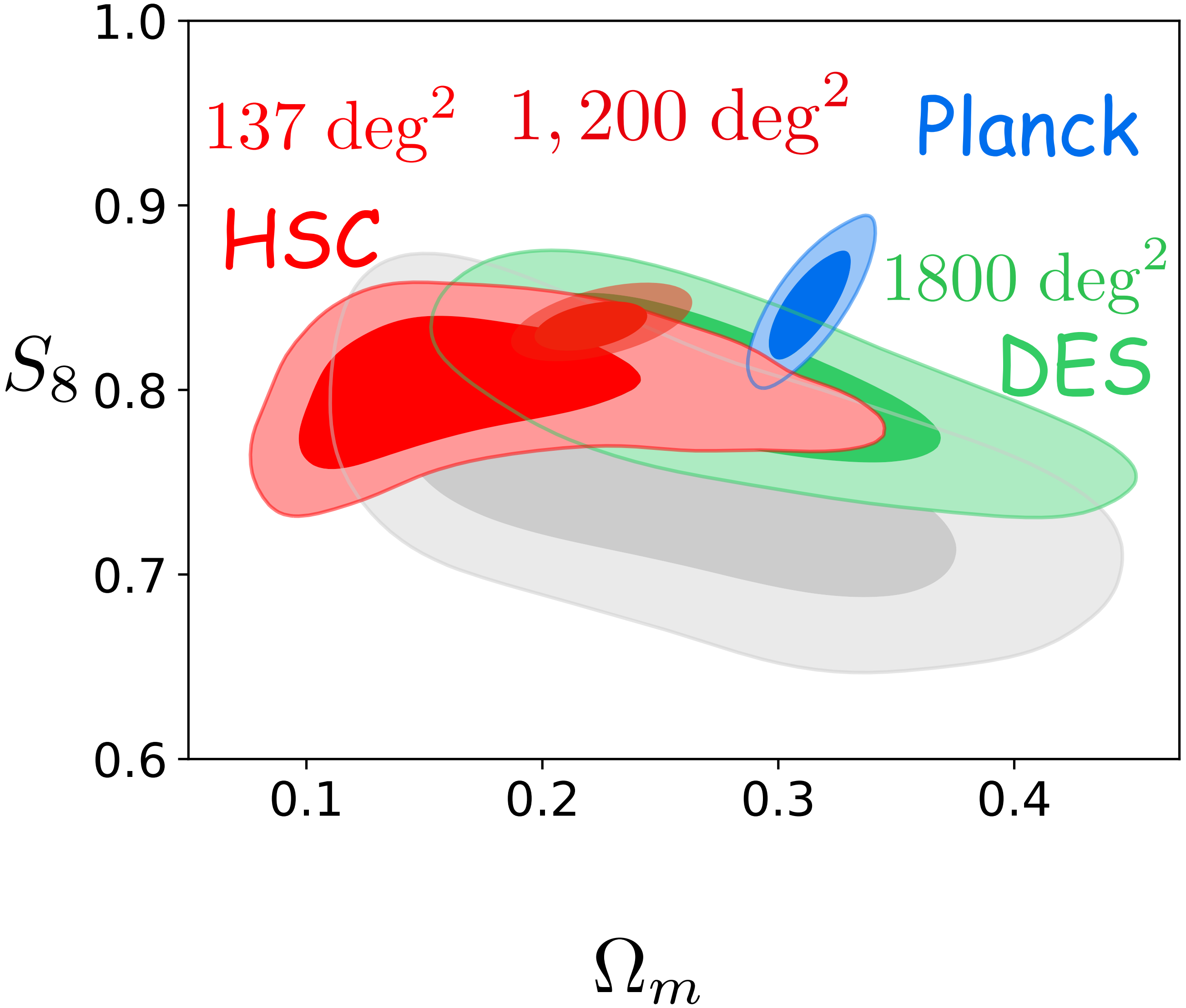
Deep:27, UD: 3.5 fully completed

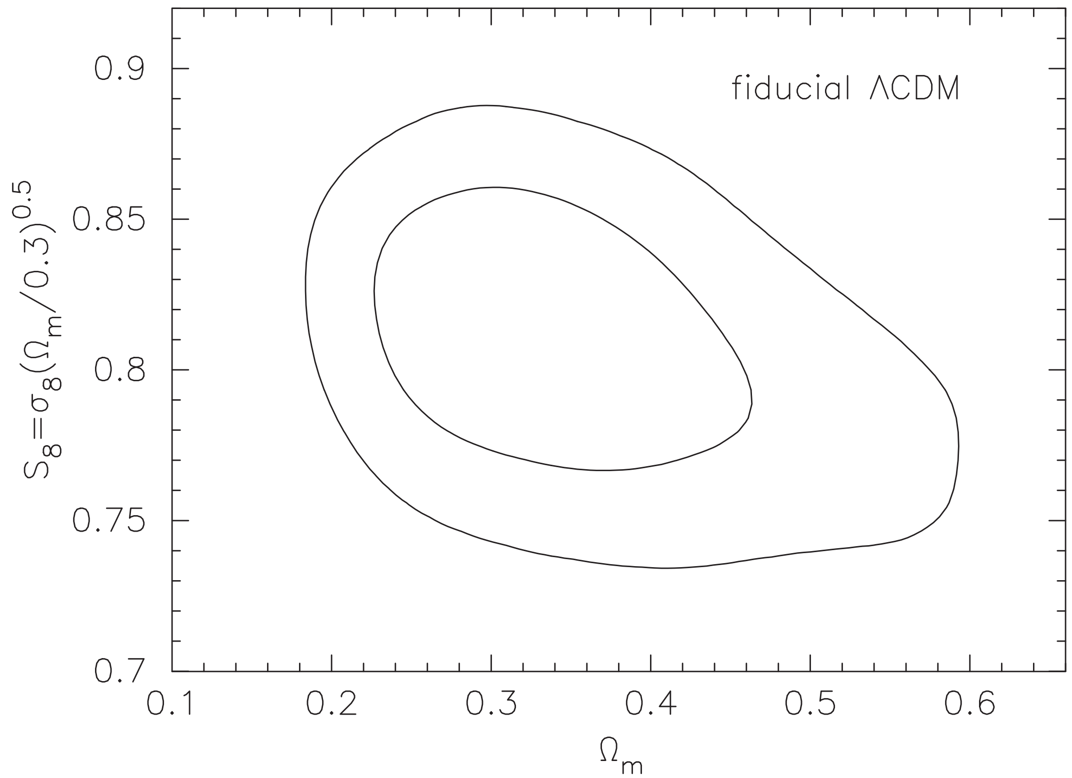
Reports on A, B, C, D will be reviewed at the final debriefing session.
Scientific achievements, number of papers and thesis, educational effect, proposal and achievements, unexpected results requests to the observatory

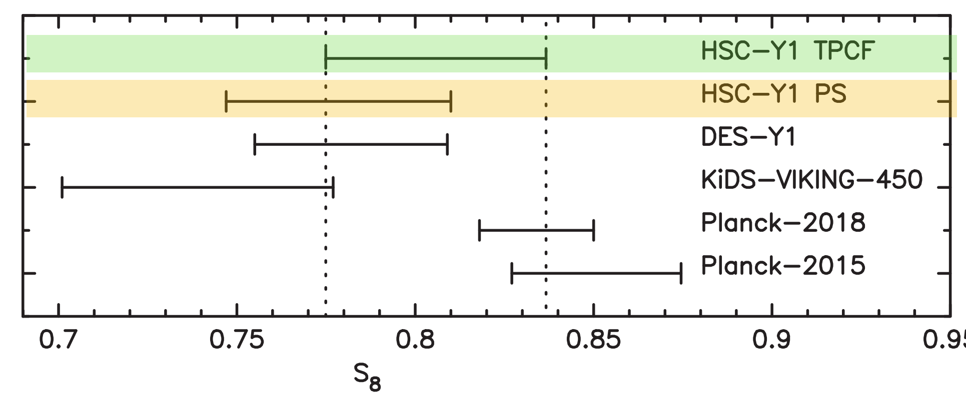
Cosmology Papers

Cosmic Shear Tomography to challenge standard LCDM

PASJ Excellent Paper Award 2020 !







Hikage et al. (2019) in Fourier space

$300 < \ell < 1900$

Hamana et al. (2020) in Real space

$\ell < 300$

The error contour is different because the observed angular scale is different.

宇宙、あと１４００億年は「安泰」　すばる望遠鏡で調査

東山正宜　2018年9月27日09時25分

中央の銀河と「暗黒物質」によって光が曲がる重

宇宙はこのまま静かに広がり続けるのか、それとも速く広がり過ぎて引き裂かれてしまうのか――。すばる望遠鏡で多くの銀河を精密に観測した結果、少なくともあと１４００億年は「安泰」だと分かった。東京大学と国立天文台などのチームが２６日、論文を公開した。

宇宙は、約１３８億年前に「ビッグバ

Cosmology Goal in Proposal

Hikage et al. δw ~ 0.14 with Planck

$$0.14 \to 0.14\sqrt{137/1100} \sim 0.05$$

Wide-field imaging with Hyper Suprime-Cam 11

Data	$w_{\rm pivot}$	w_a	FoM	γ_g	$m_{\nu,{\rm tot}}$[eV]	$f_{\rm NL}$	n_s	α_s
BOSS-*BAO*	0.064	1.04	15	–	–	–	0.018	0.0057
HSC(WL)-*B* (baseline)	0.080	0.86	15	0.15	0.16	30	0.014	0.0041
HSC(WL)-*O* (optimistic)	0.068	0.66	22	0.083	0.082	18	0.013	0.0040
HSC(WL+SN)-*B*	0.043	0.60	39	0.15	0.16	30	0.014	0.0041
HSC(WL+SN)-*O*	0.041	0.45	54	0.081	0.081	18	0.013	0.0040
HSC-*O*+[BOSS-$P(k)$]	0.028	0.36	99	0.038	0.076	17	0.011	0.0029
HSC-*O*+[BOSS+PFS]	0.027	0.19	196	0.035	0.07	17	0.009	0.0022

Table 3: Expected parameter accuracies for HSC cosmology using the Oguri & Takada (2011) shear method: The "Baseline" case ("HSC(WL)-*B*") uses clusters with $z < 1$ and masses $M_{\rm halo} > 10^{14}h^{-1}M_\odot$, and without priors on nuisance parameters, whereas the "Optimistic" case ("HSC(WL)-*O*"), uses clusters to $z = 1.4$, with some *conservative* priors on nuisance parameters. The DE constraints listed in this table are also conservative in the sense that the errors include marginalization over non-standard cosmological parameters such as γ_g, $m_{\nu,{\rm tot}}$, and $f_{\rm NL}$. The rows denoted "WL+SN" include the above HSC-WL and SNeIa measurements. The last two rows show the expected constraints when we combine the HSC observables with spectroscopic surveys, BOSS and PFS (see Ellis et al. 2012 regarding the planned PFS survey). The joint constraints assume that the HSC-WL observables can remove the spectroscopic galaxy bias uncertainty, by comparing the galaxy clustering with the dark matter distributions reconstructed from the HSC-WL observables. This analysis does *not* include constraints from cosmic shear, which is largely independent, with different systematics, and serves as a valuable cross-check.

Data Release

IDR

S16A	2016/08/04	Data used for the special issue.
S17A	2017/09/28	
S18A	2018/06/25	PDR2 on 2019/05/30. 174 nights.
S19A	2019/09/25	
S20A	2020/08/03	275 nights -> PDR3
S21A	2021/06	Possibly an incremental release (~318 nights)
S22A	2022/Summer or beyond	Final data release (330 nights). This will become PDR4

PDR

PDR1	2017/02/28	FCFD area only. 61.5 nights
PDR2	2019/05/30	174 nights
PDR3	2021/08	S20A Data release to public
PDR4	TBD	All data. Final data release. 330 nights.

< 1 year

DM pipe line is experiencing big upgrade (butler gen2 -> gen3). The final data analysis must wait until the upgrade is completed. 2022/Summer is reported to be TITGHT, possibly S22B or S23A

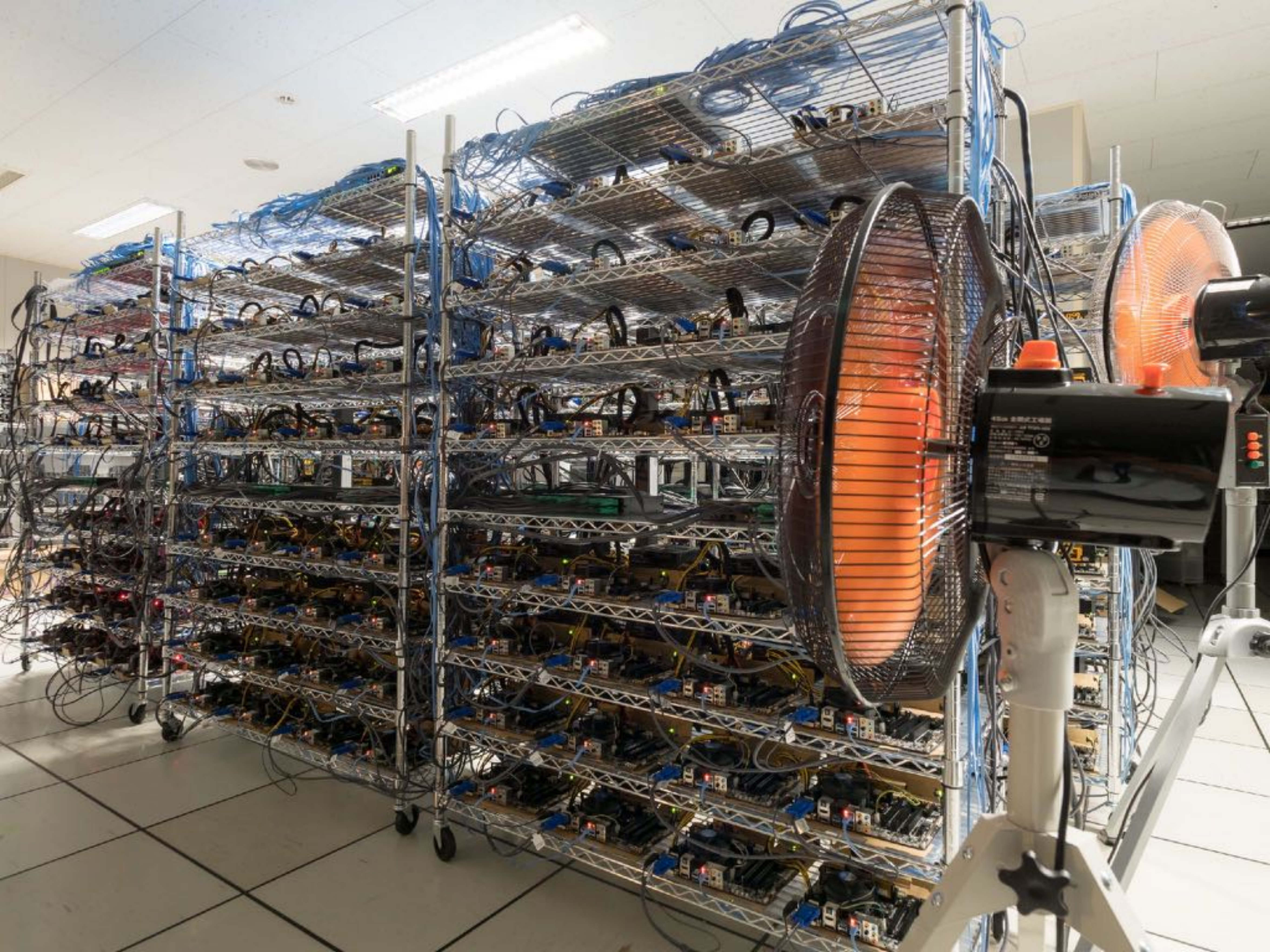
Promotion of HSC-SSP Data Utilization・・・

- The latency to the data access is a bottle neck of scientific work flow:
  - Ultra fast database and analyzer is crucial
    - ~1 G record is too large for conventional and general purpose database system
    - Completely original database and analyzer system is designed and prototyped by Koike-san.

Promotion of HSC-SSP Data Utilization・・・

Secret Weapon

- Computers (裸) transferred from CfCA
  - 1 node: 12 Core CPU x 4 + 384 GB Mem. + 4 TB SSD (↑ newly purchased)
  - 11 nodes cluster
- New system is built on the cluster



Promotion of HSC-SSP Data Utilization・・・

S20a_wide (PDR3) ~ 1000 deg^2

Inquire of number of records ・・・usually takes 1 ~ 2 min

In [1]:
```
from quickdb.sqlhttp import sqlclient
```

Count

In [5]:
```
sql = '''
SELECT count(*) from s20a_wide
'''

%time res = sqlclient.post_sql(sql)

res.dataframe()
```

```
CPU times: user 1.88 ms, sys: 1.8 ms, total: 3.68 ms
Wall time: 146 ms
```

Out[5]:

	$group_by	col0
0	None	830139306

146 ms on quickdb

Promotion of HSC-SSP Data Utilization・・・

2D

Generation of CM diagram

In [11]:

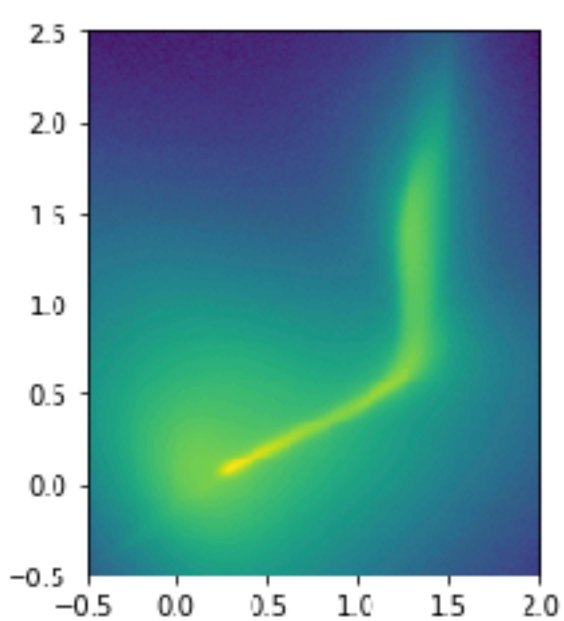
```
sql = '''
SELECT
    histogram2d(
        forced.g.psfflux_instmag - forced.r.psfflux_instmag,
        forced.r.psfflux_instmag - forced.i.psfflux_instmag,
        bins => (200, 400), range => ((-0.5, 2.), (-0.5, 2.5)))
FROM
    s20a_wide
WHERE
    forced.i.extendedness_value < 0.5
'''

%time res = sqlclient.post_sql_with_tqdm(sql)

import numpy
hist, xedges, yedges = res.target_list[1][0]
pyplot.imshow(numpy.log(1 + hist).T, origin='lower', extent=(xedges[0], xedges[-1], yedges[0], yedges[-1]))
```

```
100%|██████████| 528/528 [00:01<00:00, 331.39it/s]
CPU times: user 26.4 ms, sys: 11.2 ms, total: 37.5 ms
Wall time: 1.6 s
```

Out[11]: <matplotlib.image.AxesImage at 0x7fb64a5b40d0>



1.6 s on quickdb

~ $US100K

If we scale up this by 20 times larger,

then LSST data can be handled;

a big original contribution to LSST