HI Tomographic Survey in the SSA22 field (SSA22-HIT)

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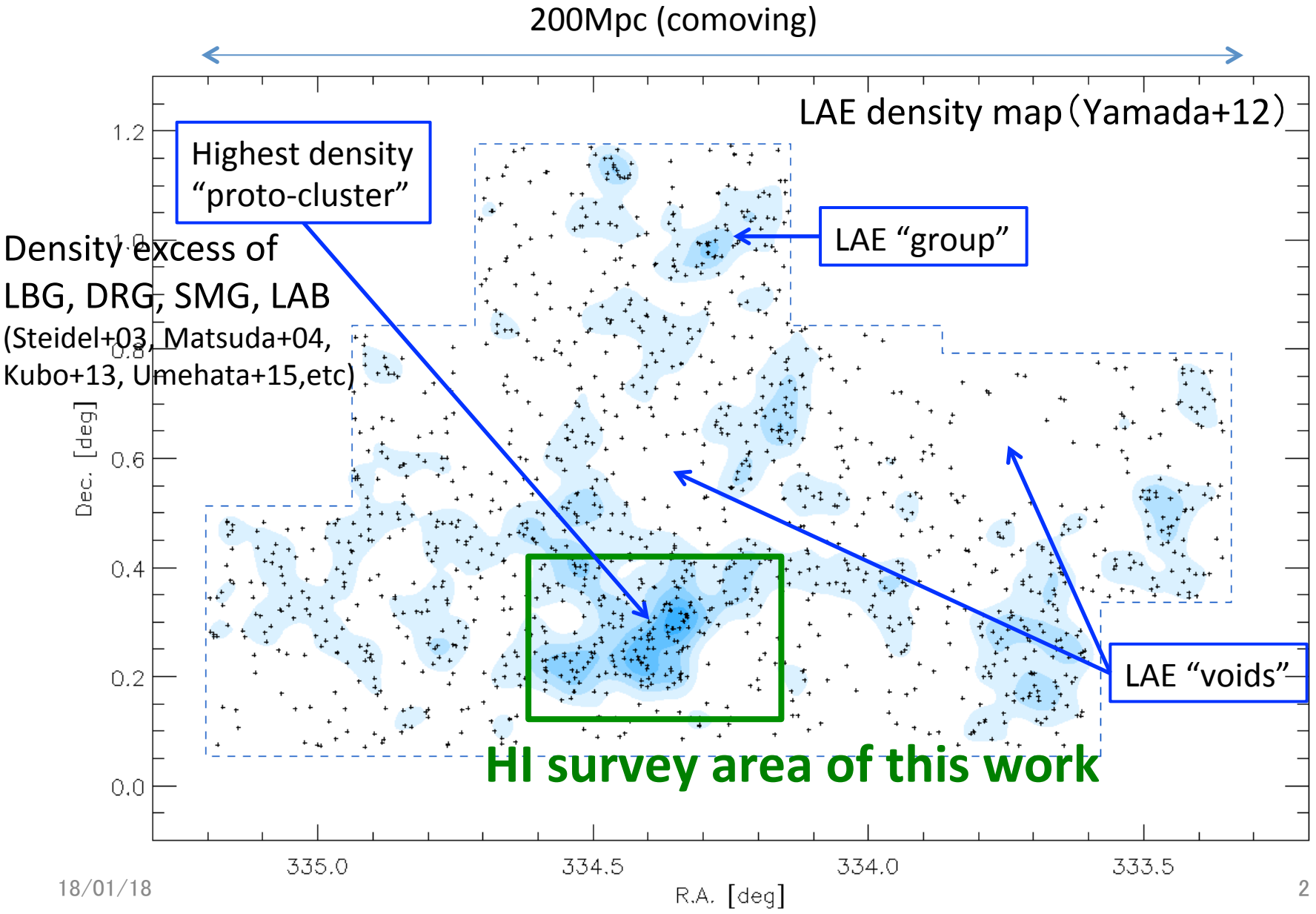
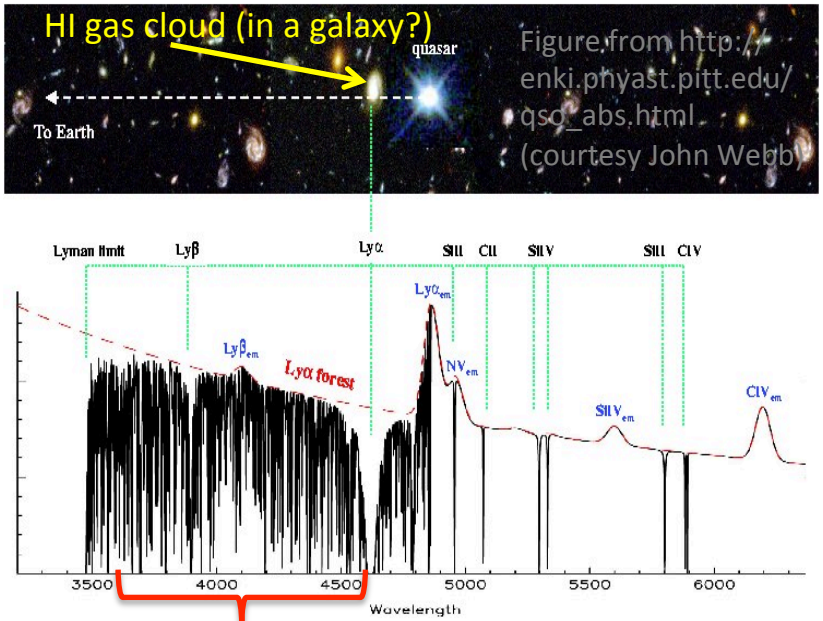
The SSA22 field



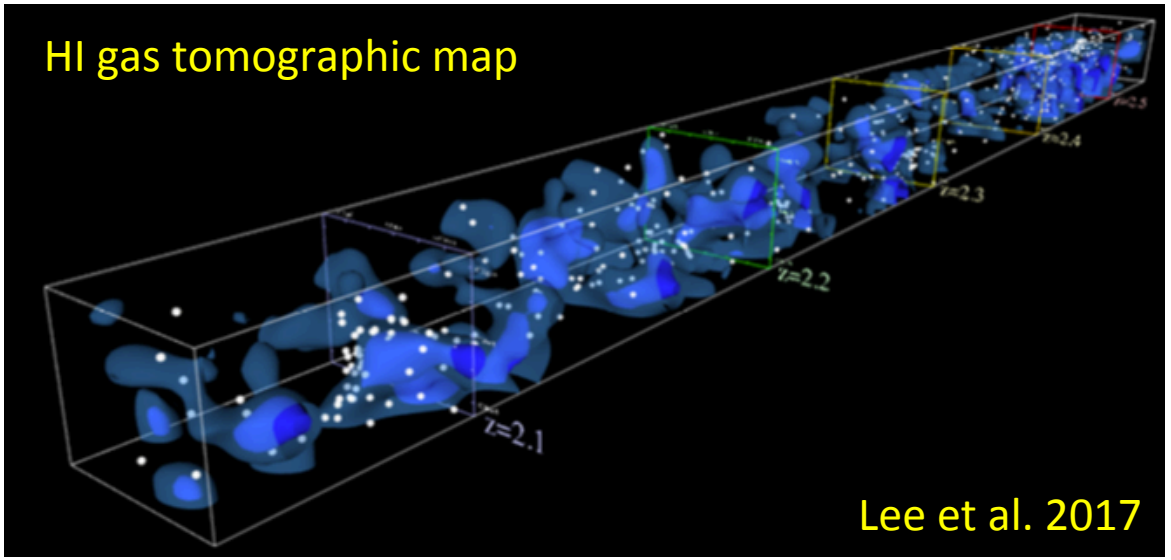
Study of Gas LSS in the high-z Universe

(1) Gas in-/outflow between IGM and Galaxies are fundamental phenomena in the galaxy formation/evolution.

(2) Large Scale Structure (LSS) survey via galaxies and gas is a hot topic in the next surveys (e.g., Subaru/PFS).



Abs lines caused by different redshift gaseous absorbers



Gas can be investigated via absorptions in the background objects' spectra.

HI Tomography (HIT) survey with Keck/DEIMOS

Panoramic survey of both HI and galaxies at z = 2.5 – 5.5

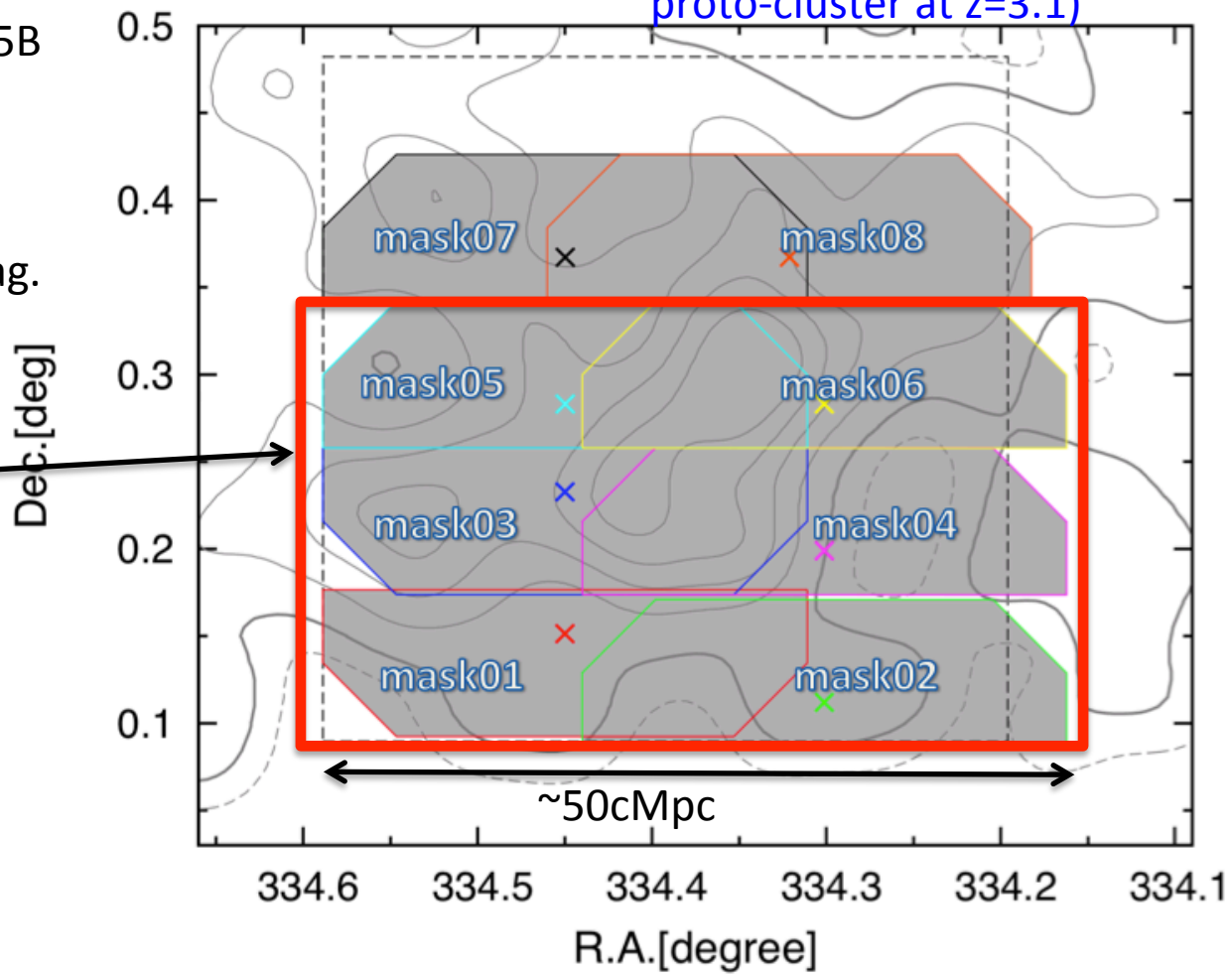
5 nights in S15B, 2 nights in S16A, and
4 nights in S16B were awarded for
Subaru-Keck time exchange.
We got additional 2 nights in S15B
in UC time.

Targets are
~500 LBGs with i' = 24-25.5 mag.

Data was taken for the 6 masks so far.

- 600ZD (R~1500)
- λ = 4000 – 9000Å

6 masks in the **SSA22** field
(including the prominent
proto-cluster at z=3.1)



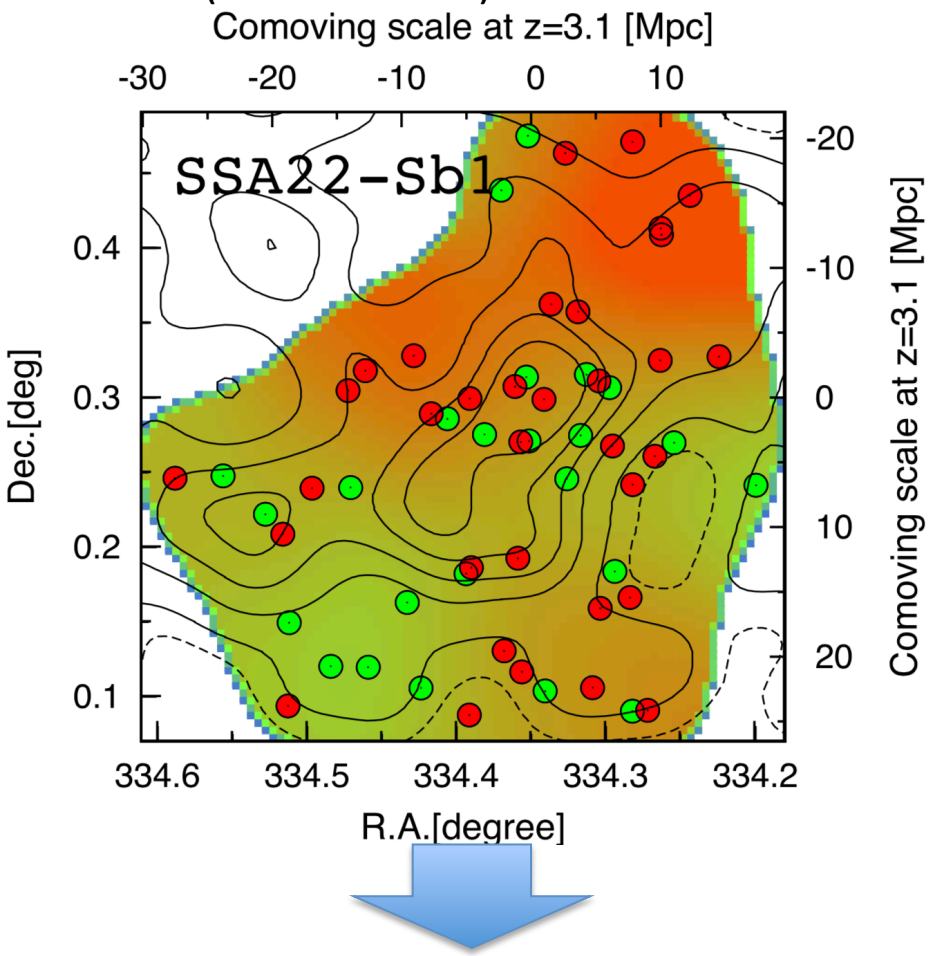
Main Science (1)Galaxy-Gas spatial correlation

It's not clear whether HI gas distribution align with galaxy distribution.

While some simulations predict positive correlation on ~ 10 Mpc scale (Cai+15, Stark+14), our recent observational work suggests no correlation.

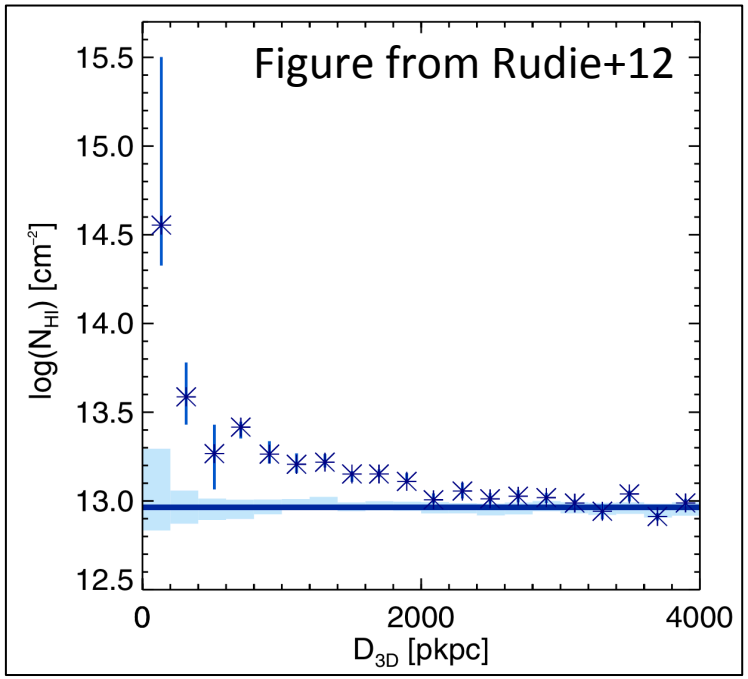
Comparison between observations and simulations will be needed to understand HI-gal (no) correlation.

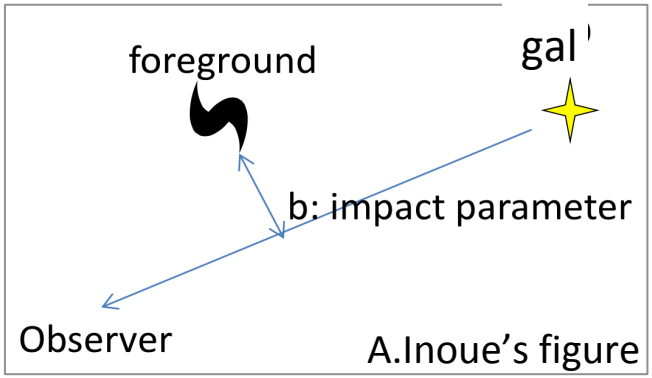
2D HI map at z = 3.1
(Mawatari+17)



Higher resolution 3D map from HIT

Main Science (2)CGM HI & metal abs halo





CGM halo can be investigated by measuring HI/metal absorptions as a func of impact parameters.

Main Science (3)LSS survey with z > 4 galaxies

Previous photo-z analysis showed a redshift peak at z > 5. There may be another proto-cluster.

Current data Summary

	Integration time [hour] in total	Integration time [hour] in 2015	2σ depth @5000Å per resolution [AB]	Goal depth: ETC 2σ per resolution in 4 h	Nspecz / Nobj
mask01	2	2	24.6	25.8	12/86
mask02	2	2	24.8	25.8	27/78
mask03	7.8	2	24.7	25.8	23/84
mask04	8	2	24.8	25.8	28/86
mask05	7.9	3.6	24.9	25.8	27/93
mask06	13.5	4.6	25.1	25.8	35/86
Total					152/513

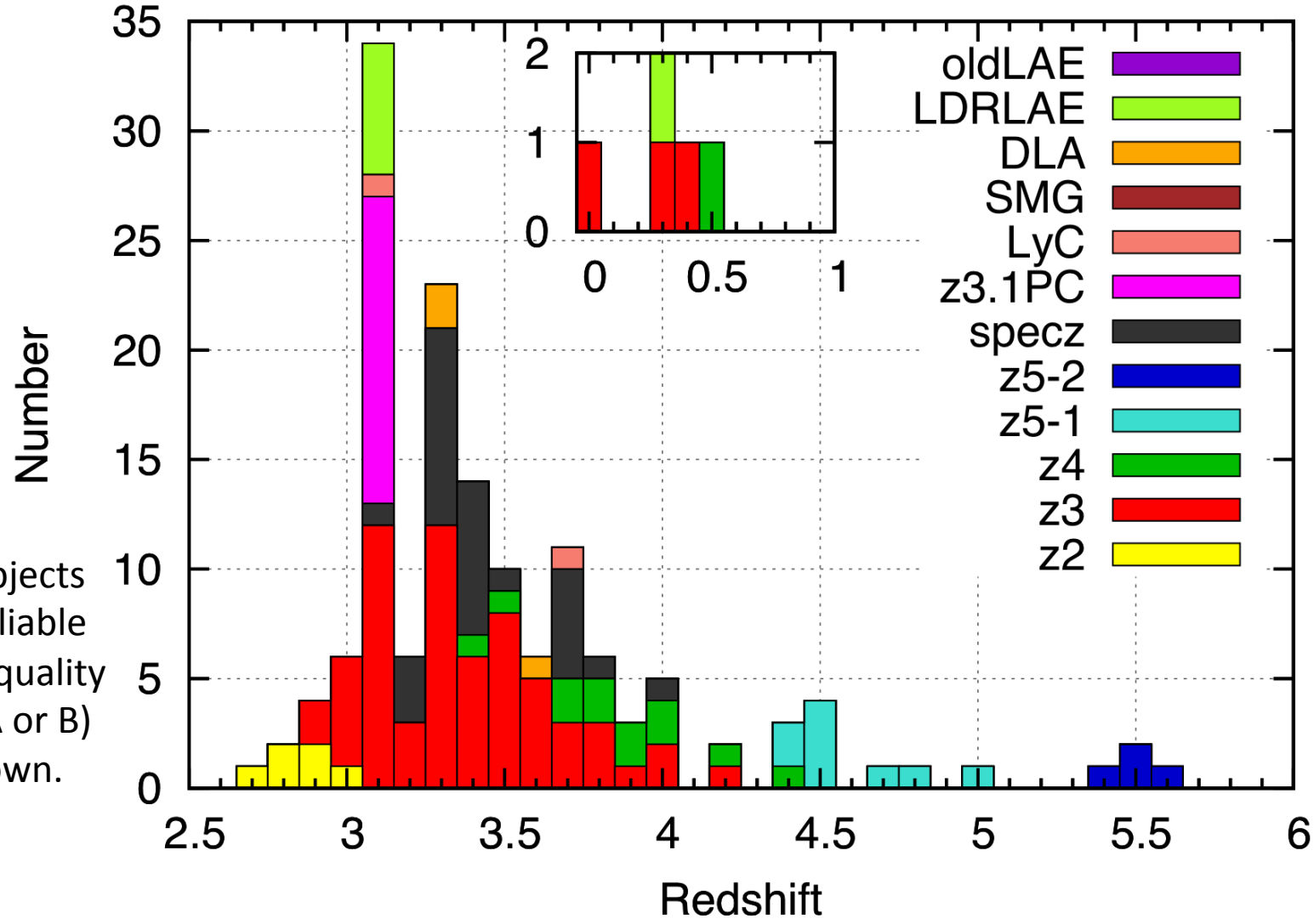
shallower than expected….

124 are newly determined

We show the results from data taken in 2015. Final products are not ready.

Redshift determination

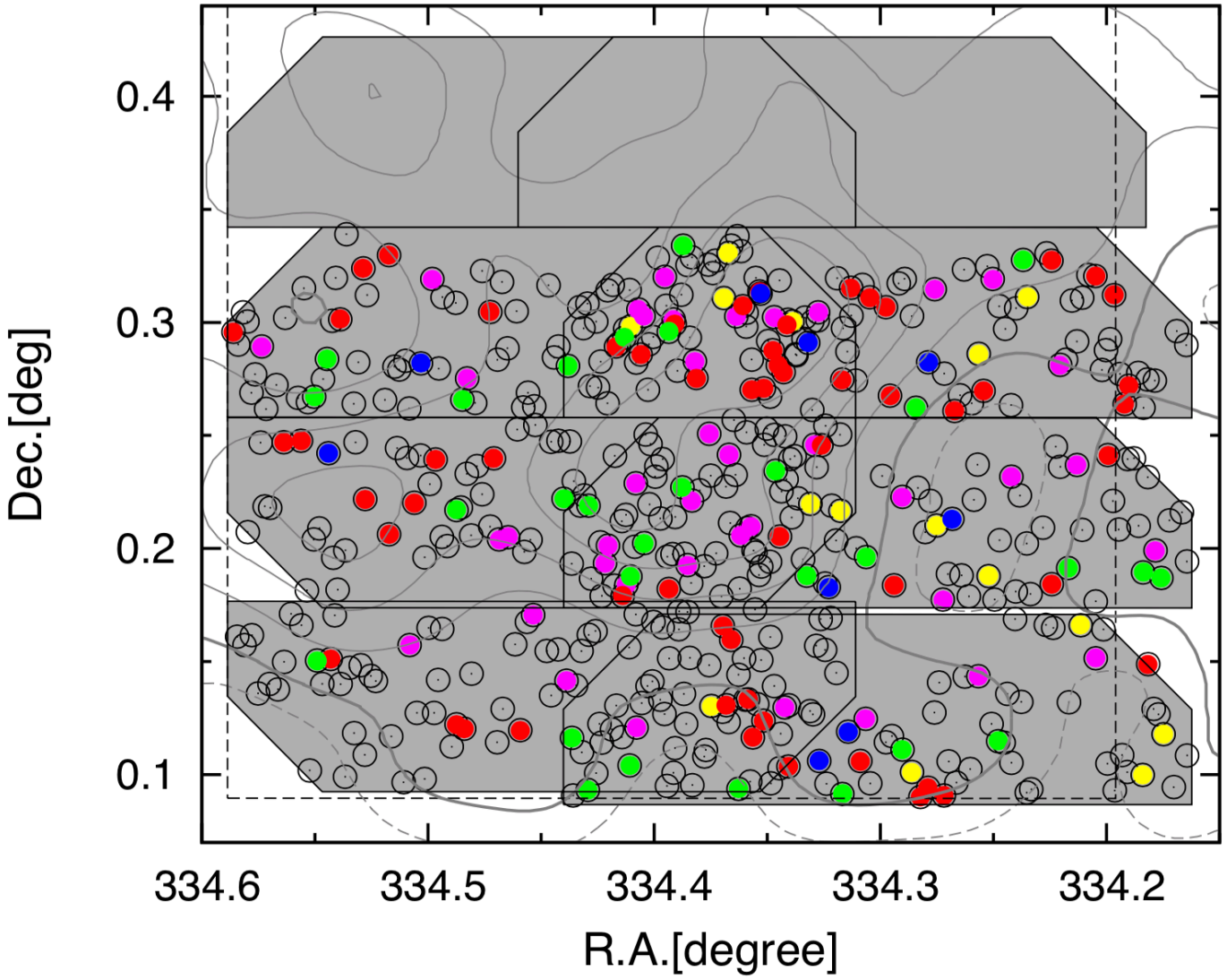
- Redshift histogram for each category



Only objects with reliable specz (quality flag = A or B) are shown.

Redshift determination

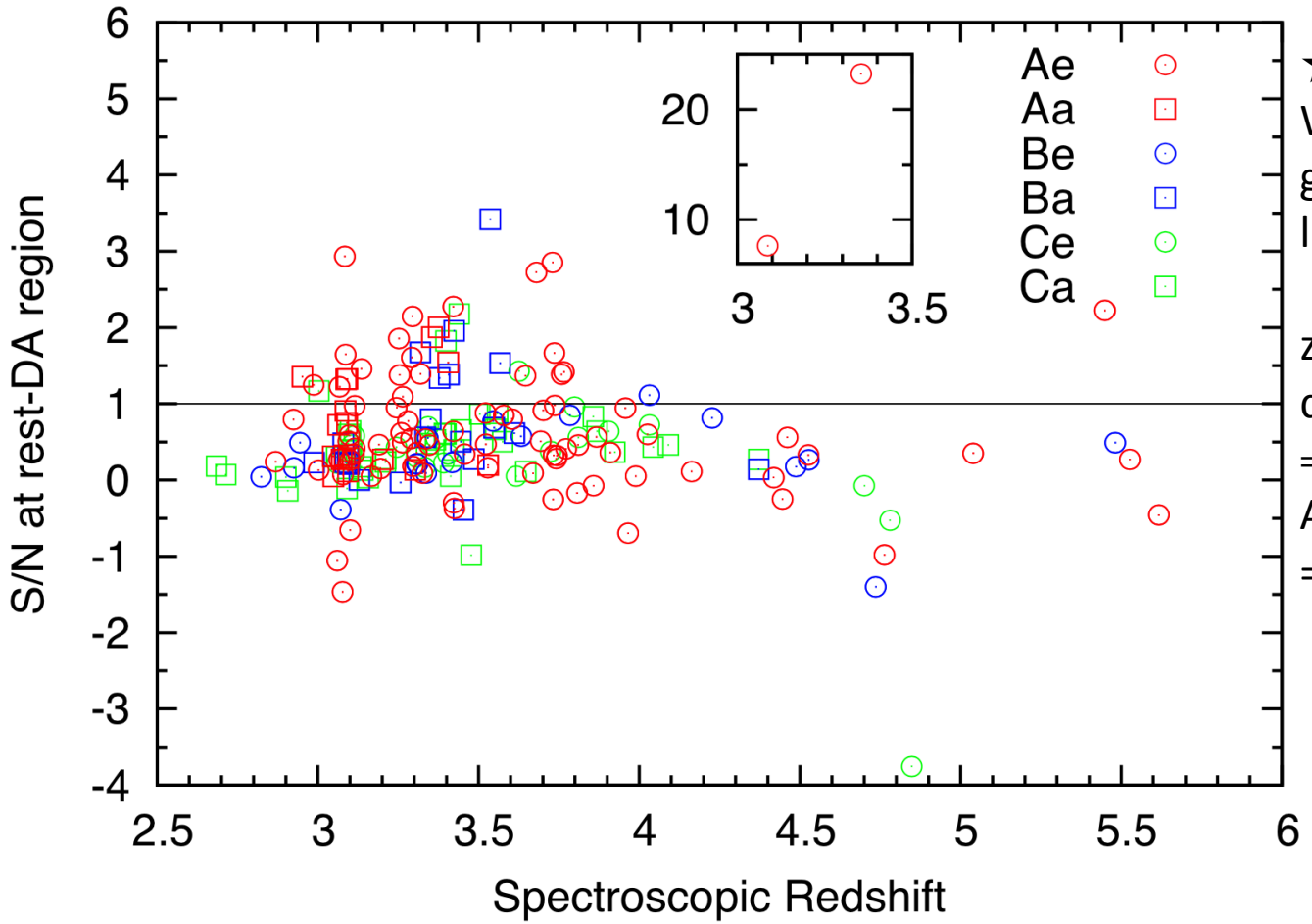
Sky distribution of A and B objects



All targets
z<3
3<z<3.2
3.2<z<3.7
3.7<z<4.5
z>4.5
Scam deep
z=3.1 LAEs

Surface density of
3.2<z<3.7 gals
= 0.17 arcmin^{-2}
, corresponding to
~ 1 Mpc spatial resolution
for z=3.1 HI tomography

S/N at the DA wavelength range



★CGM study for z=3.1 LAE
We need to use z=3.2-3.7 galaxies as background light sources.

z=3.2-3.7 galaxies with quality flag of A or B
⇒ 59
Among them, S/N > 1
=> 19

We need to smooth spectra or to stack of plural sight-line spectra, even after merging the 2nd year data.

Summary

- IGM tomography in the SSA22 proto-cluster region is an unique survey.

- We spent 13 Keck/DEIMOS nights to survey a ~ 50 x 30 Mpc^2 area in the z ~ 3 Universe.

- Achieved depth is ～0.8 mag shallower than expected from ETC. This is not due to the weather condition.

- The data reduction is still on-going, but the first year data show that (1)the data quality is enough for specz confirmation of background galaxies (for tomography) but (2) their S/N in the DA range is too low.

- We plan to complete merging the all data (1st + 2nd year) and redshift determination this Jan ~ Mar.