Natures of galaxies with different HI environments
~~ISM properties and AGN activities of z=1.4–2.7 galaxies~~
explored by "expensive" spectroscopic survey with SWIMS

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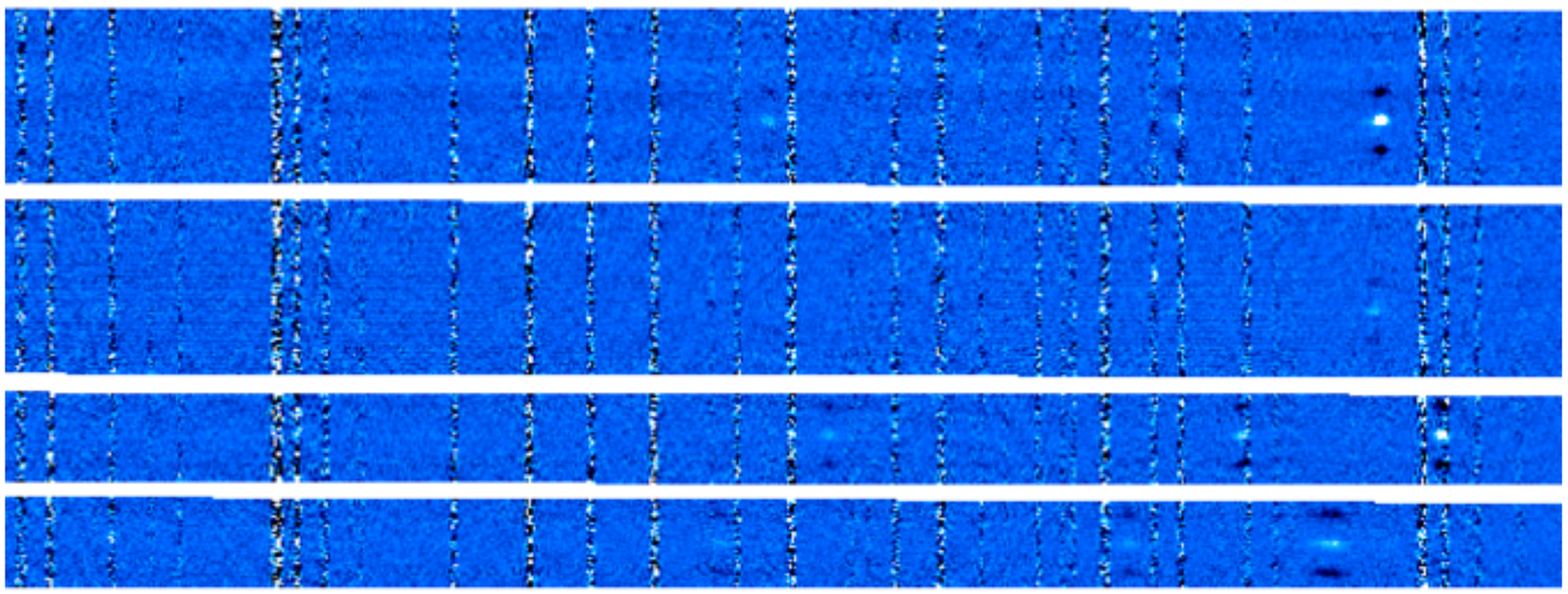


MOSFIRE H-band spectra; *RS, TK, Steidel et al. 2015b*

ABSTRACT

1. Cosmic Heterogeneity by Environmental Effects

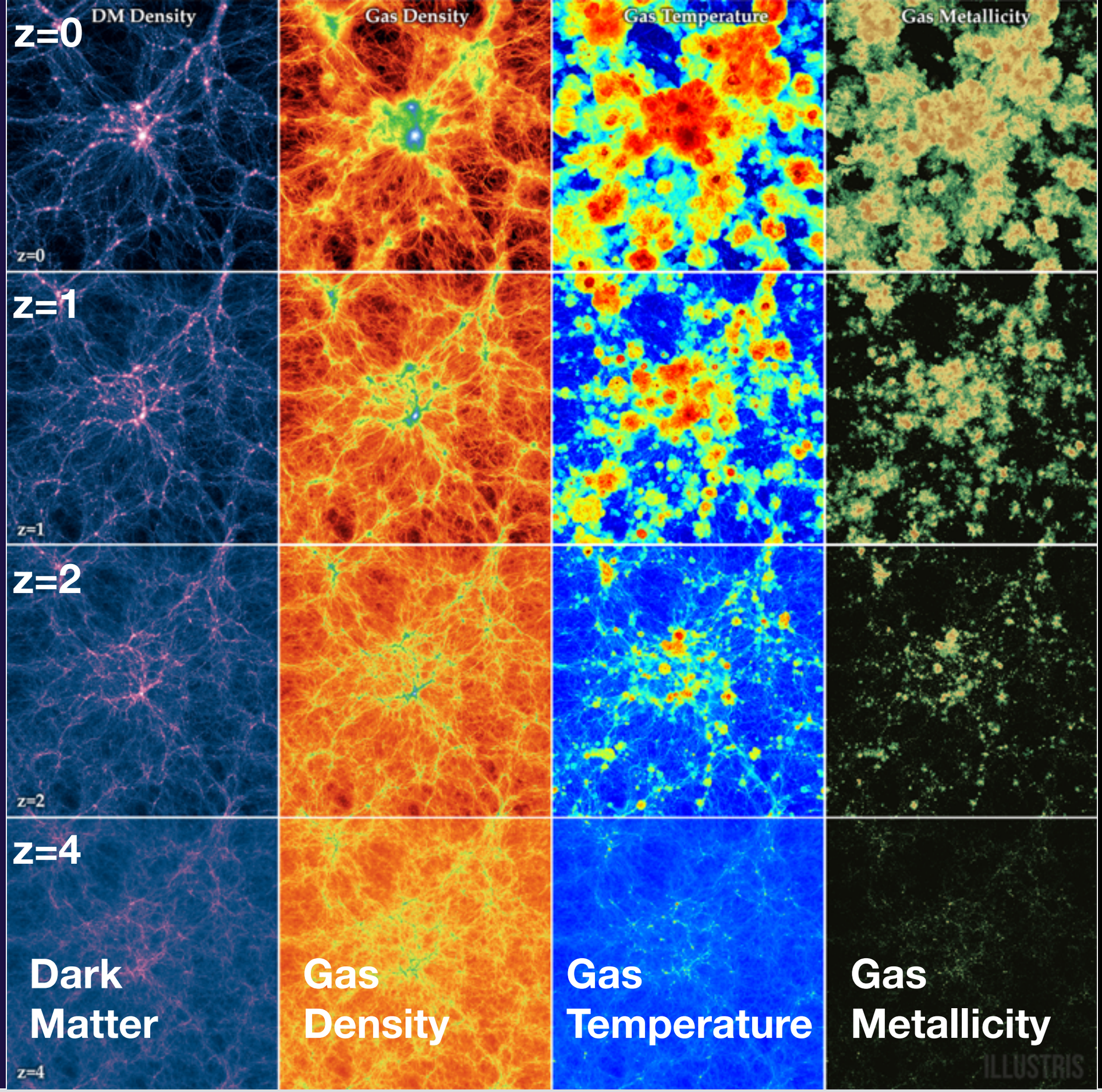
2. Current spectroscopic results

3. Search for relations between galaxies and H_I environment by HSC and SWIMS

-> MY PROPOSAL

1 deg^2 NB imaging & spectroscopic survey with HSC & SWIMS

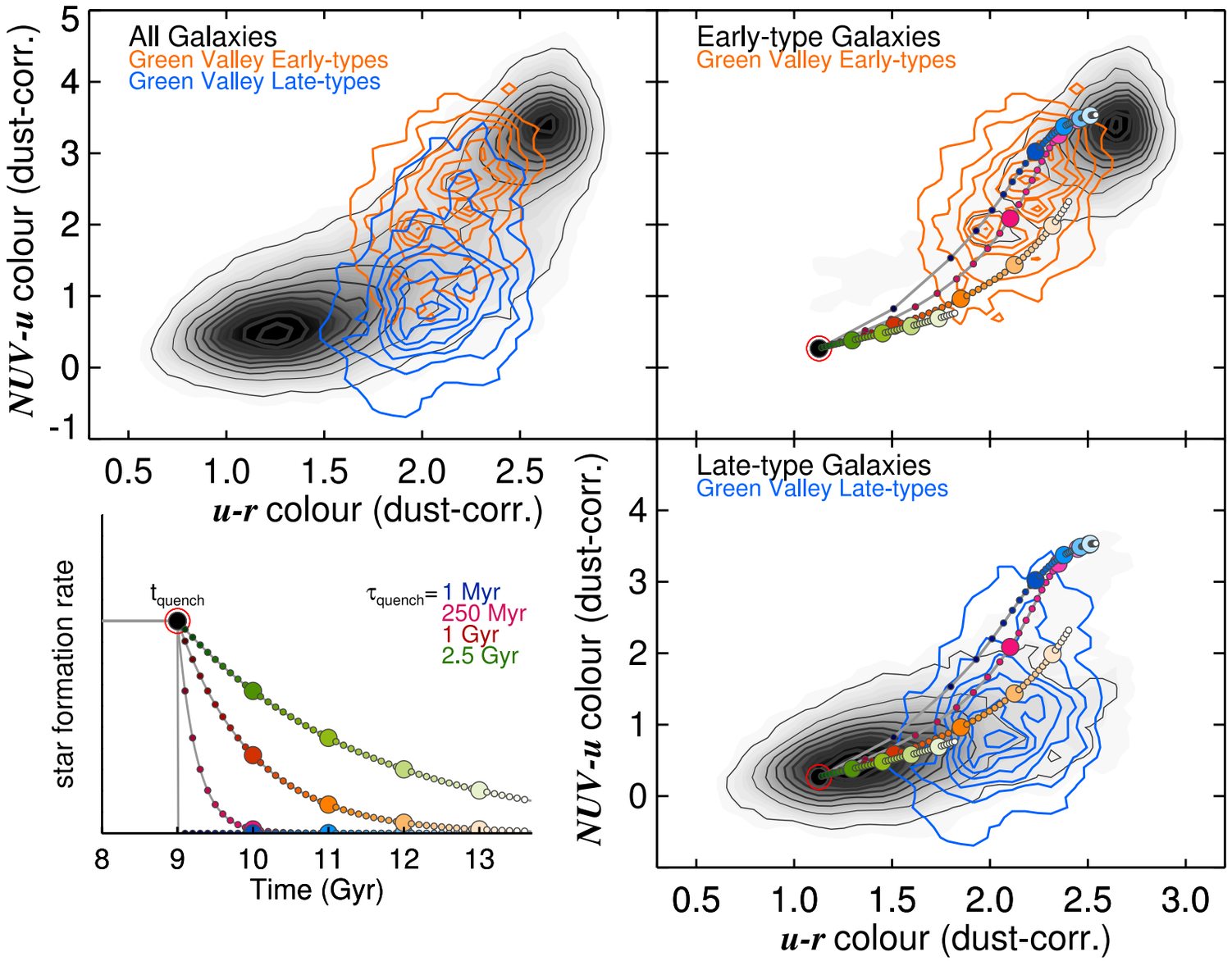
COSMIC HETEROGENEITY OF GASEOUS PROPERTIES



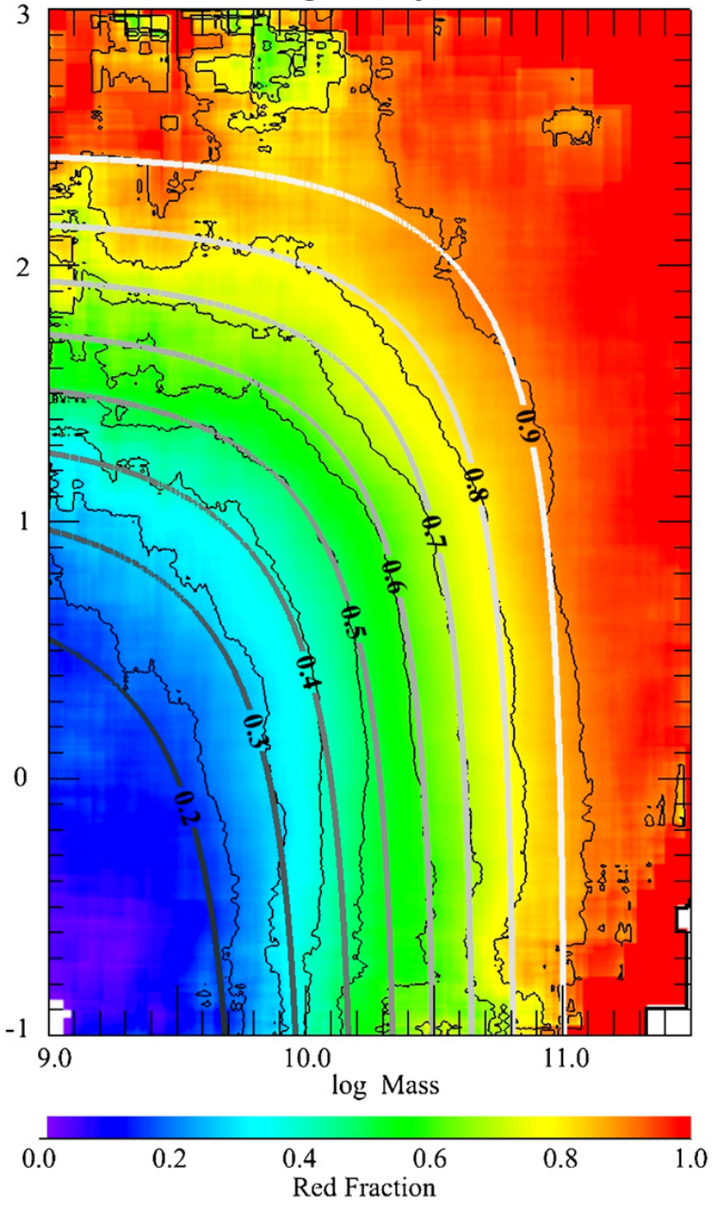
Environmental Effects

1. Halo mass and environment derive quenching of star formation independently
2. Red early-type galaxies are formed within much shorter timescale than late-types
3. The peak of cosmic star formation density history in overdense region is earlier
4. 5. 6. …

Schawinski et al. 2014

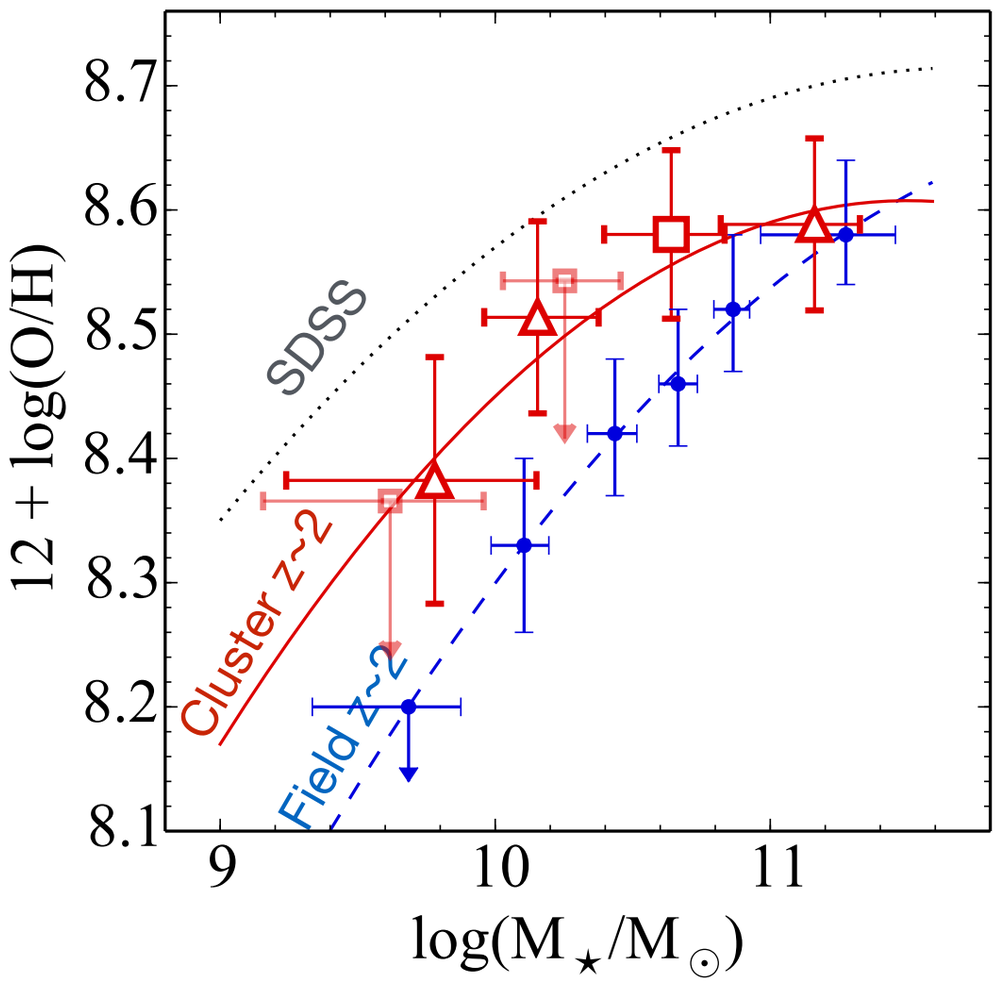


Peng, Lilly et al. 2010

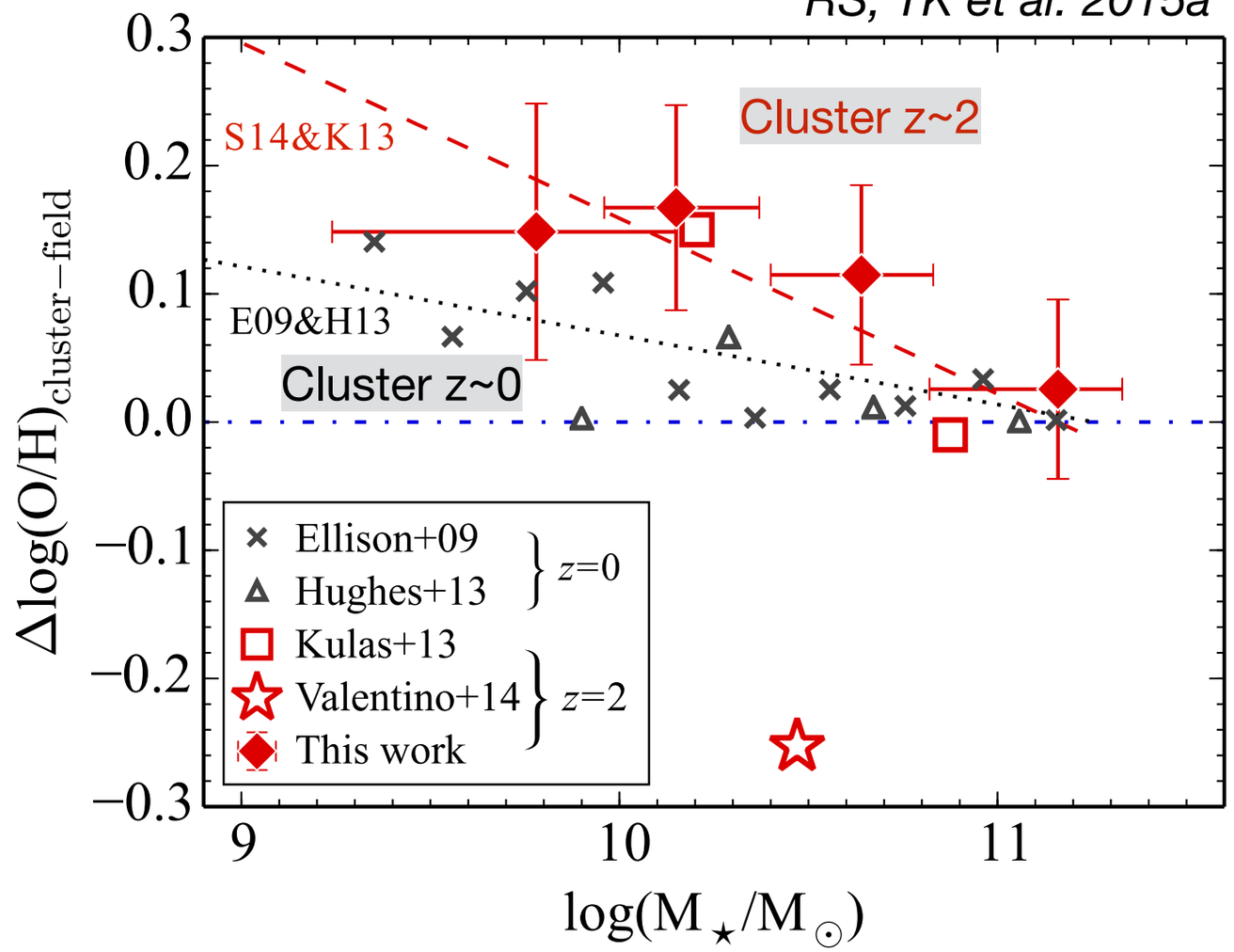


Recent results by spectroscopic analysis of SFGs in high-z clusters

- We see the enhancement of gaseous metallicities in less-massive galaxies
- The metal excess is likely more prominent at higher redshifts
- z=2-3 is the peak epoch of inflow/outflow rates, which may cause strong environmental dependence of chemical enrichments in high density regions
- But, conflicting results have been reported by Valentino+15, Kacprzak+15

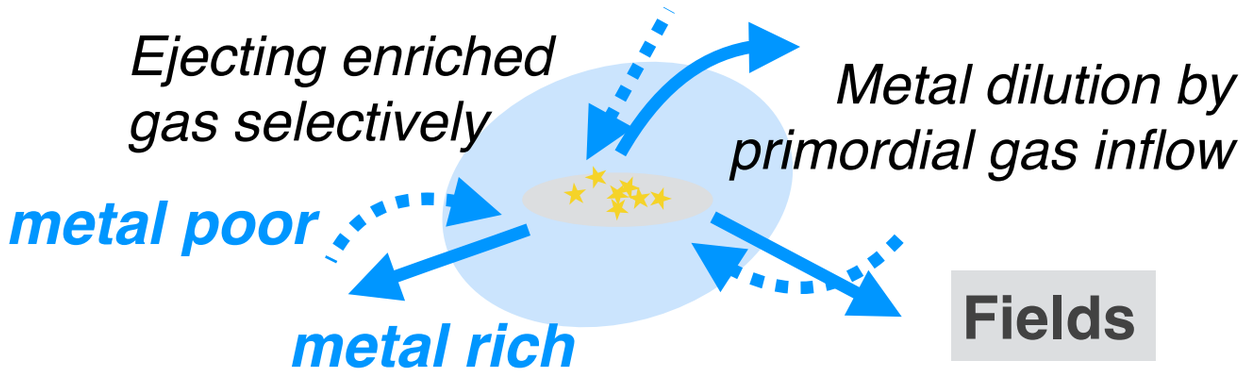


RS, TK et al. 2015a



Environmental effects on gaseous transferring at the cosmic high noon

Gas feeding mechanism is varied at z=2-3
Study for cold gas content is a crucial key to constrain such feeding mechanisms

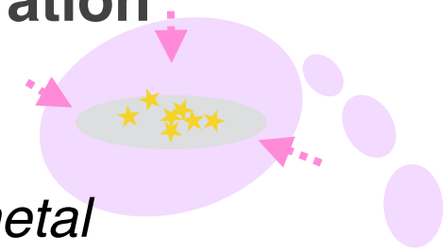


Clusters (haloes are predominantly hot)

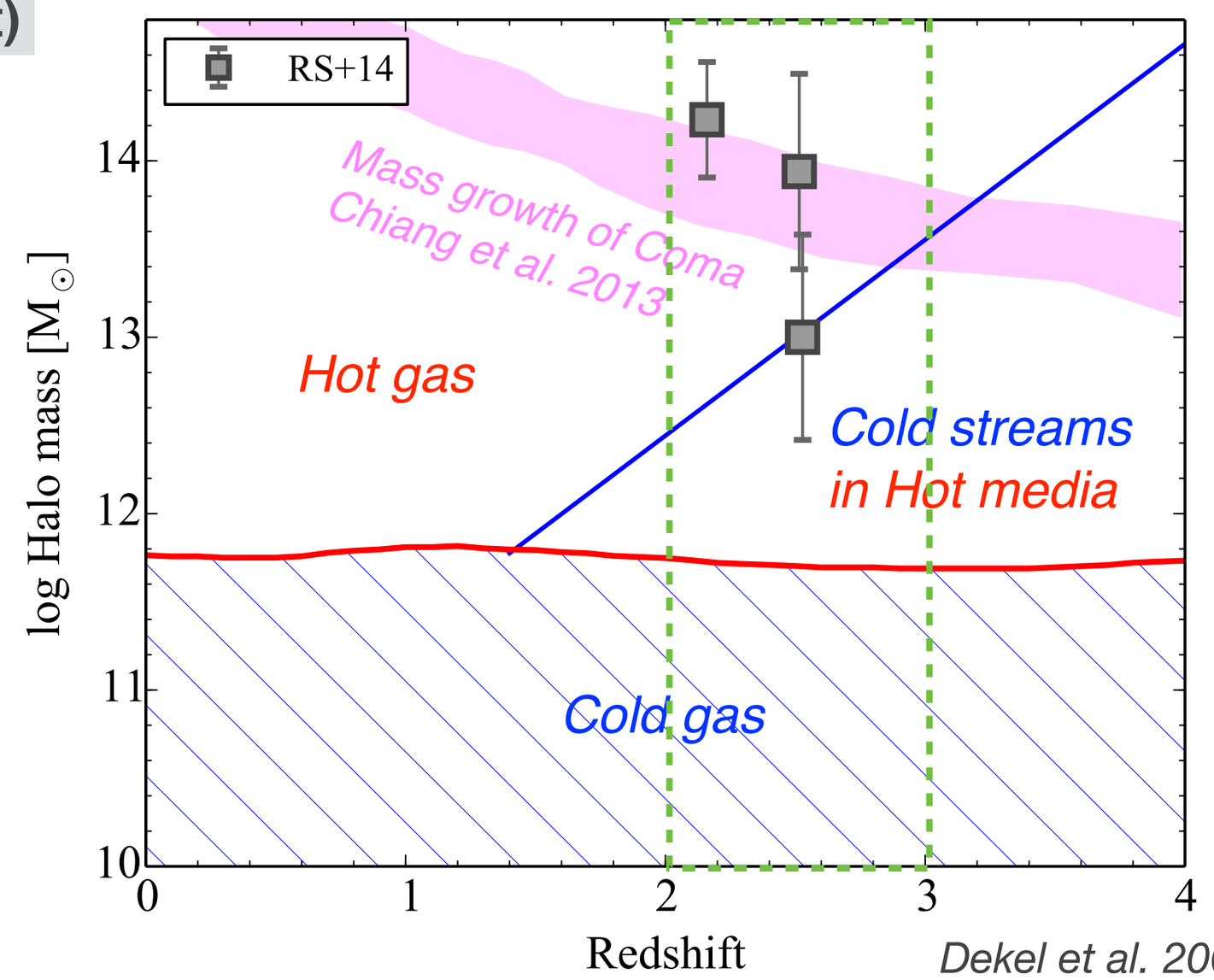
Gas recycling

Chemically enriched gas moves back

Stripping halo gas or evaporation



Stripping metal poor envelope, or hot gas shuts out gas inflow



Dekel et al. 2009

Search for relations between SFGs and HI environment by HSC & SWIMS

Golden redshift range of z=2.1–2.6 can cover both Lyα and Hα emission lines

SWIMS:

NB imaging – Hα emitters

MB imaging – DRGs

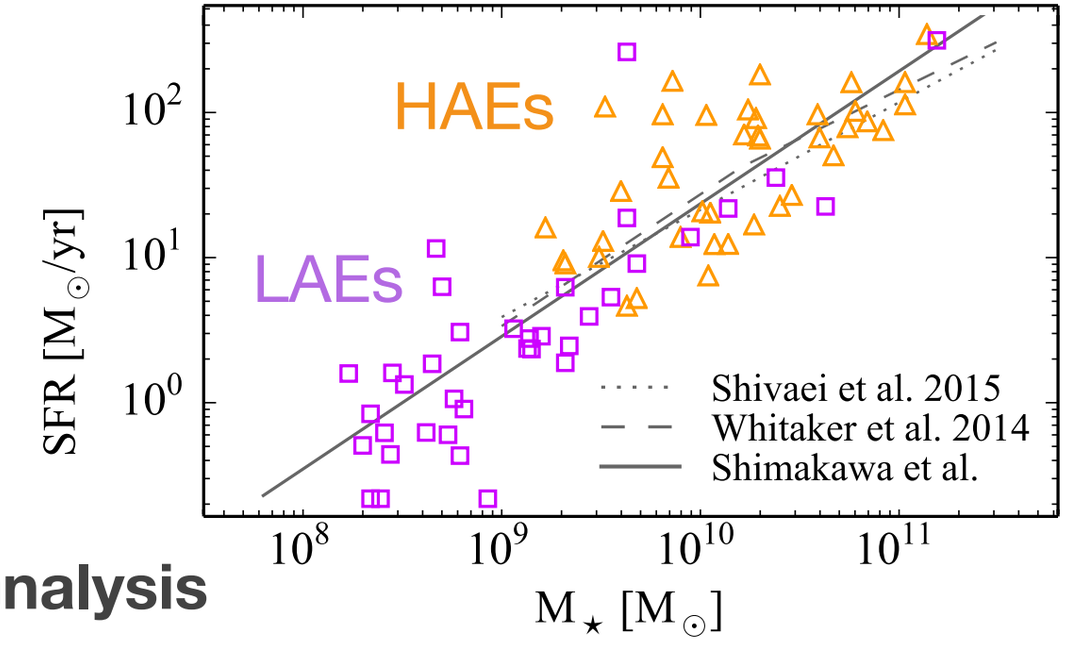
Spectroscopy – SF galaxies – line analysis

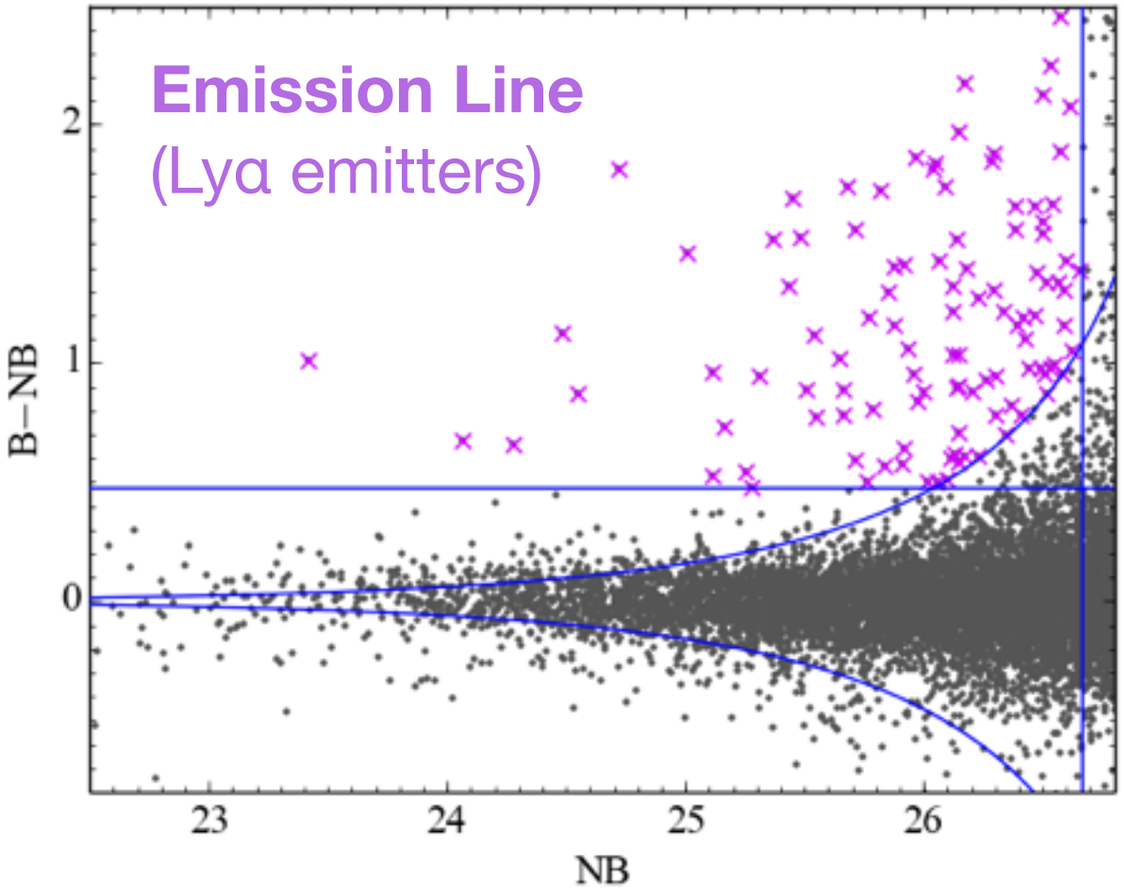
HSC:

NB imaging – Lα emitters/absorbers

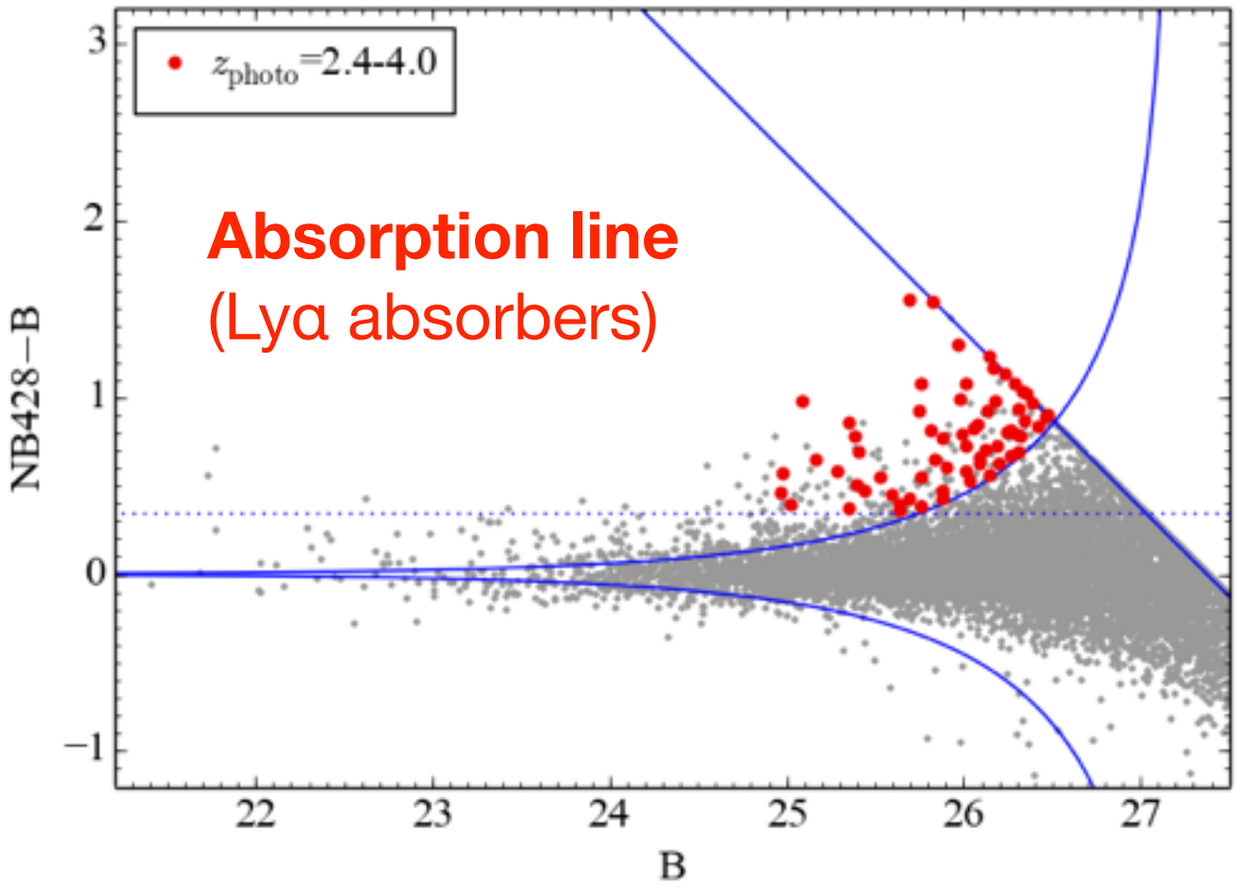
PFS:

Spectroscopy – galaxies – line/absorption analysis





RS, TK, Shibuya et al. to be submitted.

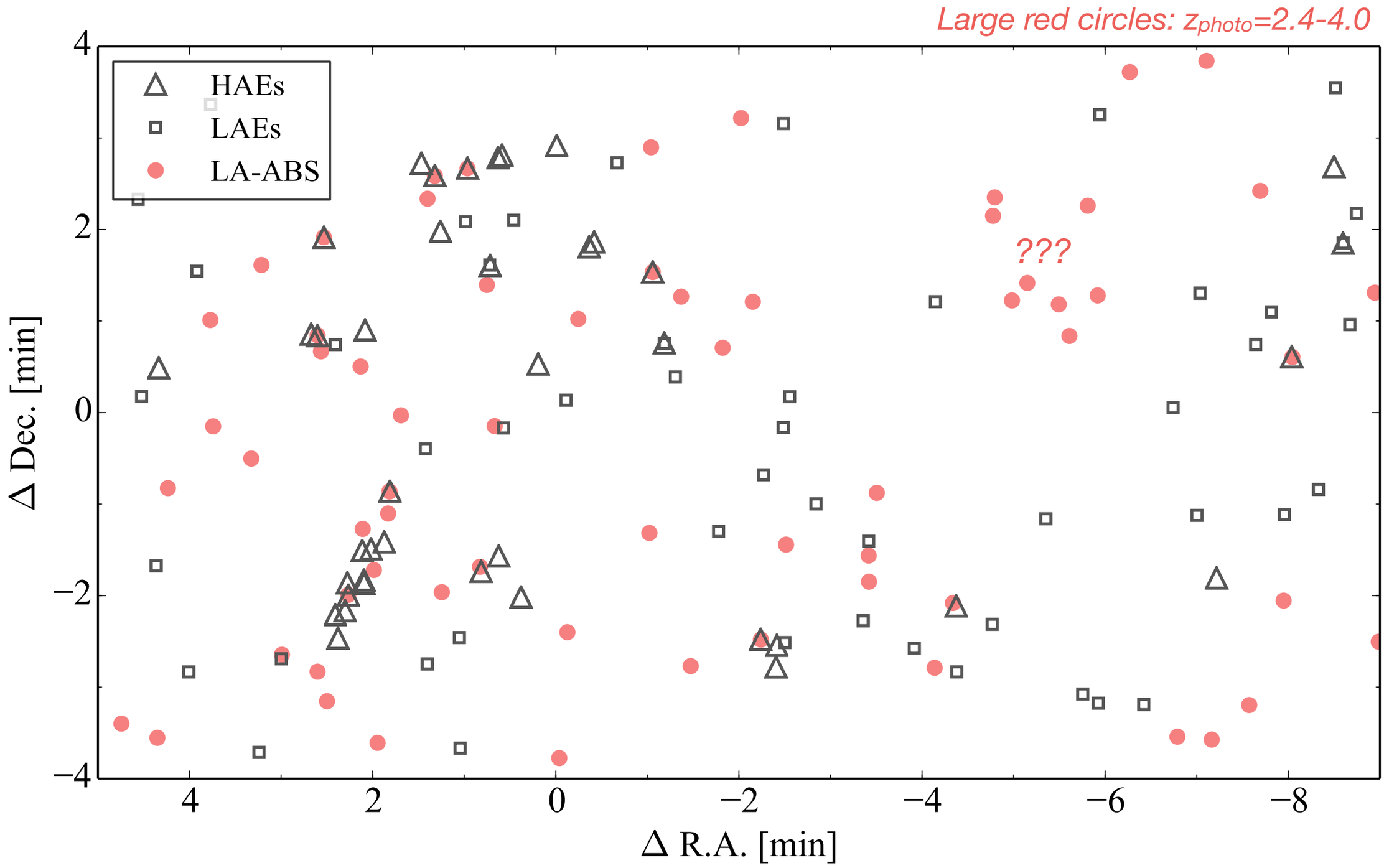


RS, TK, Kashikawa et al. in prep.

Mapping IGM & HAE & LAE (preliminary result: individual galaxies)

We can see that Lyα absorbers follow galaxy distribution

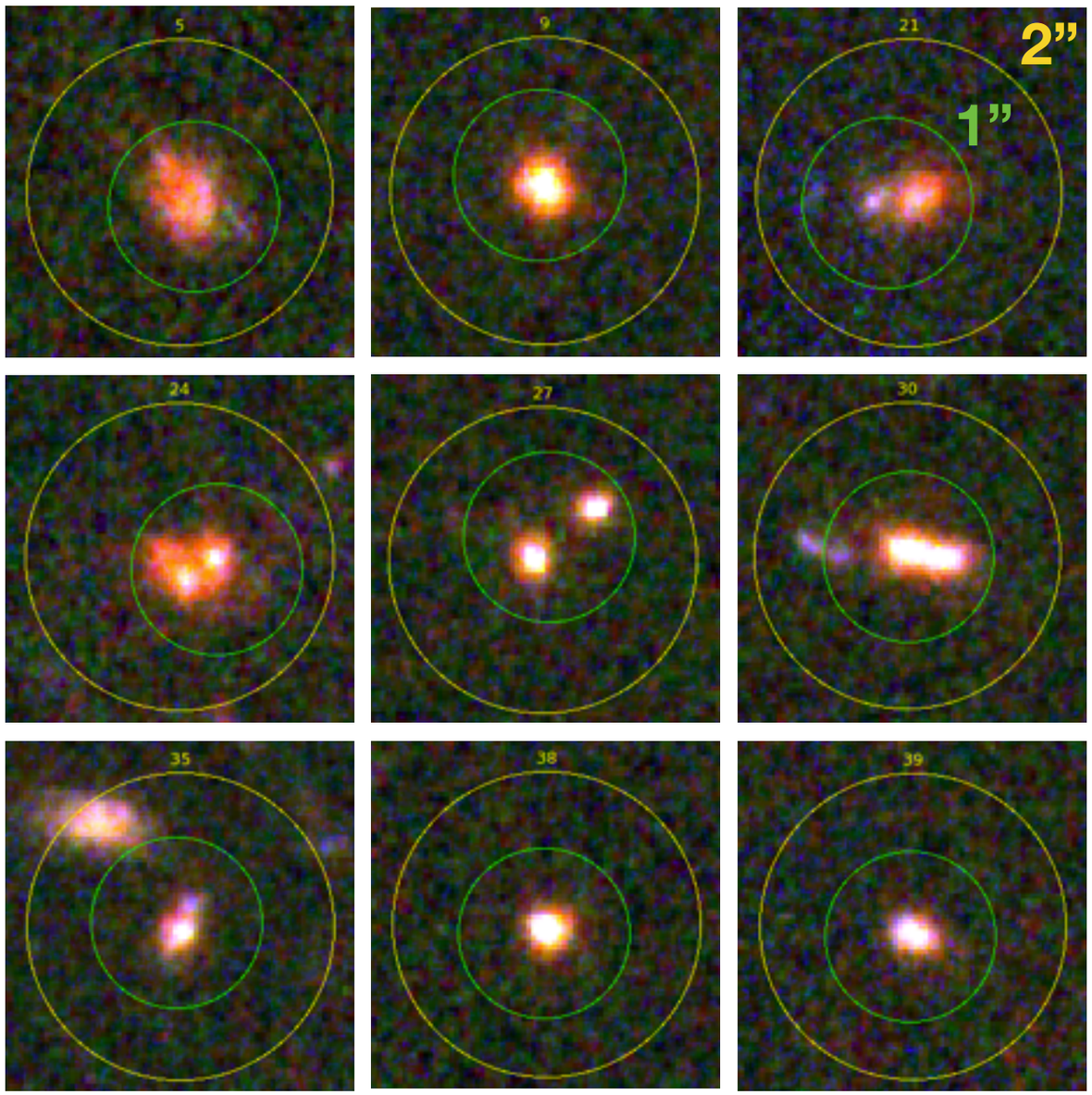
There is a large filament of H_I and galaxies through NE to SW?



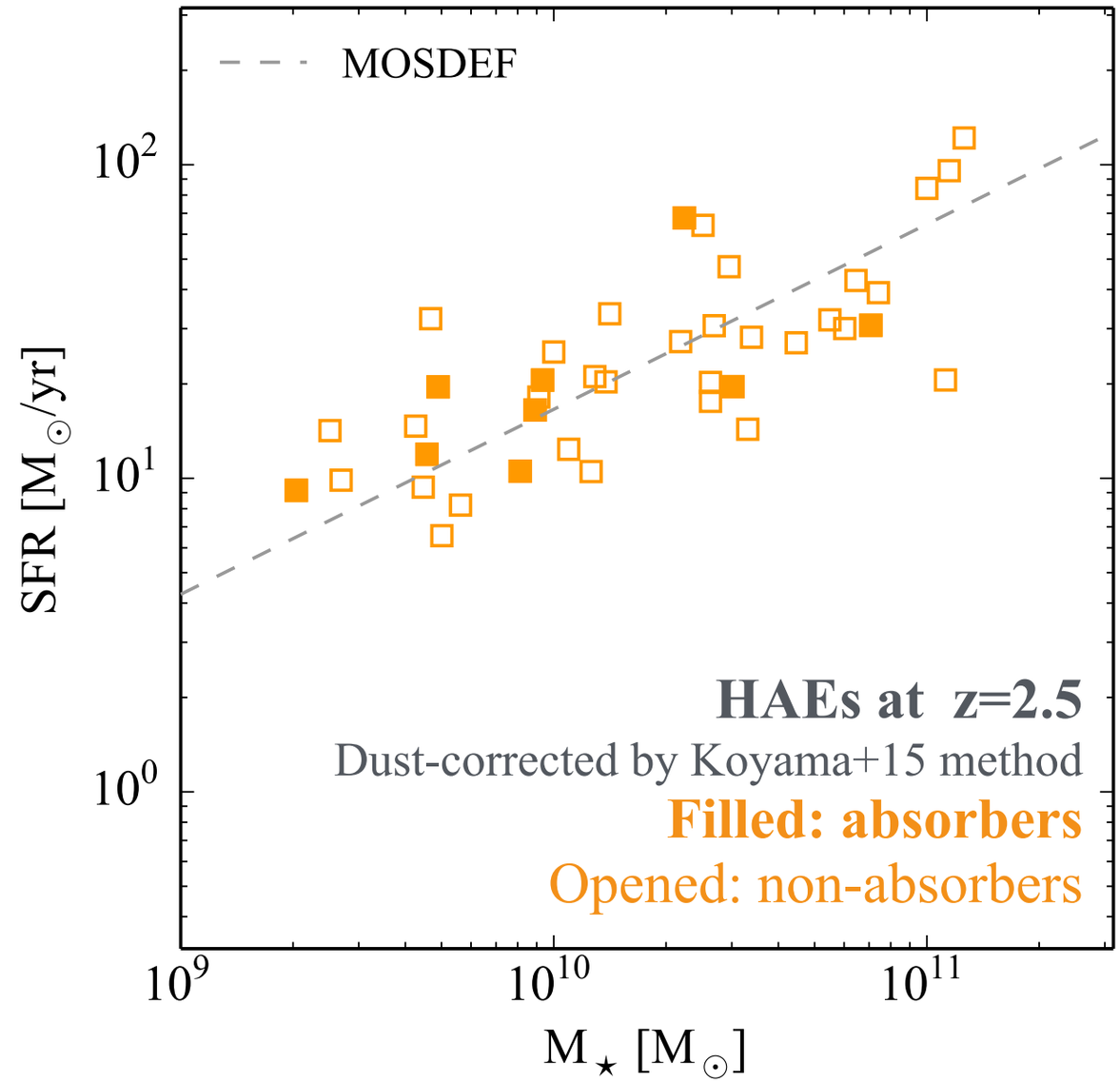
Mapping IGM & HAE & LAE (preliminary result: self-absorption, CGM)

We detect Lyα self-absorption systems (CGM) in 9 Hα emitters (/44: ~20%)
Further study (e.g. comparison with physical properties) is now going on…

HST images of 9 Lyα self-absorbers

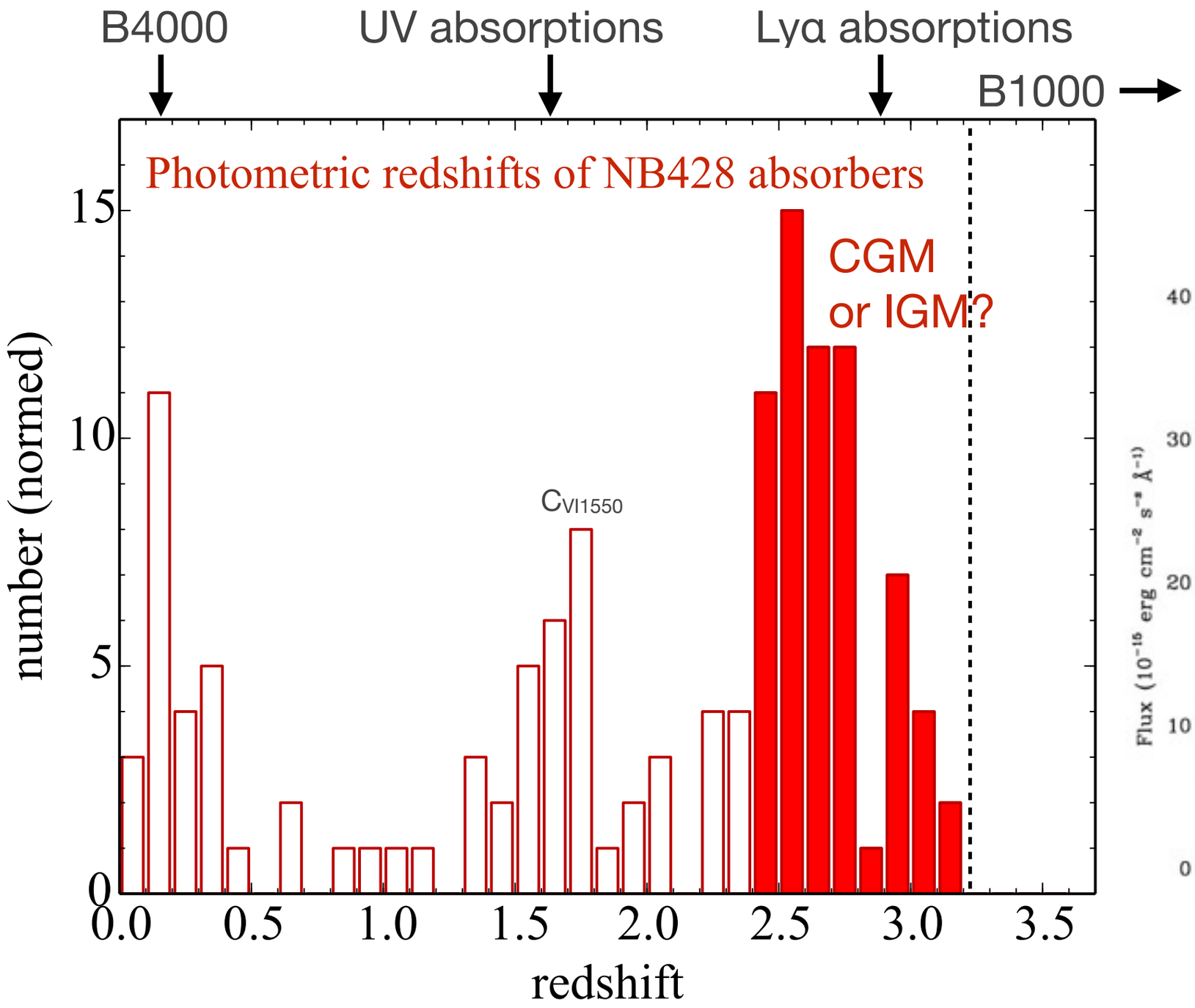


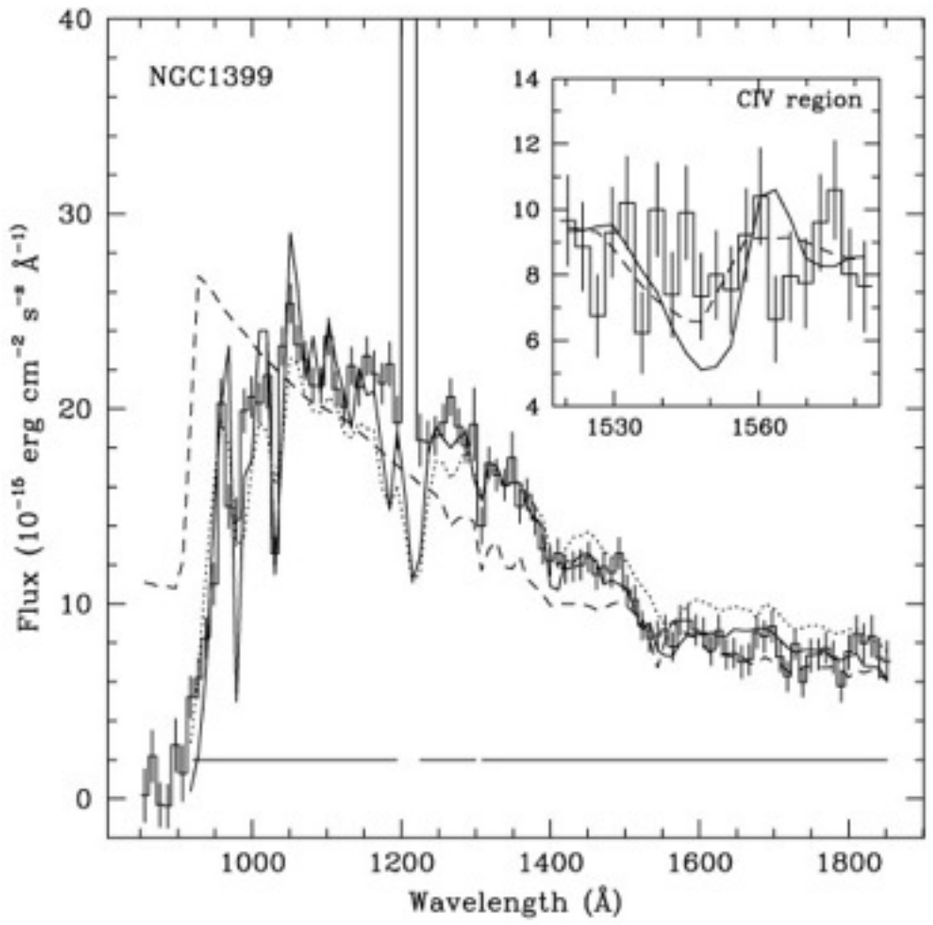
Current small sample does not show any strong dependence



Present big issue

We do not have spec-z sample for background sources
This makes hard to make sure what these absorptions/breaks are





My proposal

1 deg^2 imaging and spectroscopy with HSC&SWIMS

Pair filters of HSC - 3D density map of cold gas & 3D distribution of LAEs
Pair filters or spectroscopy of SWIMS - 3D distribution of SFGs

Follow-up spectroscopy by SWIMS

- Redshift confirmation of HAEs & LAEs at z~2.2
- Identification of background UV bright sources at z=2.2-2.8
- Study for gaseous physical properties (Z,U,SFR,Dust)

PFS has also a great capability to confirm Lyα emission/absorption

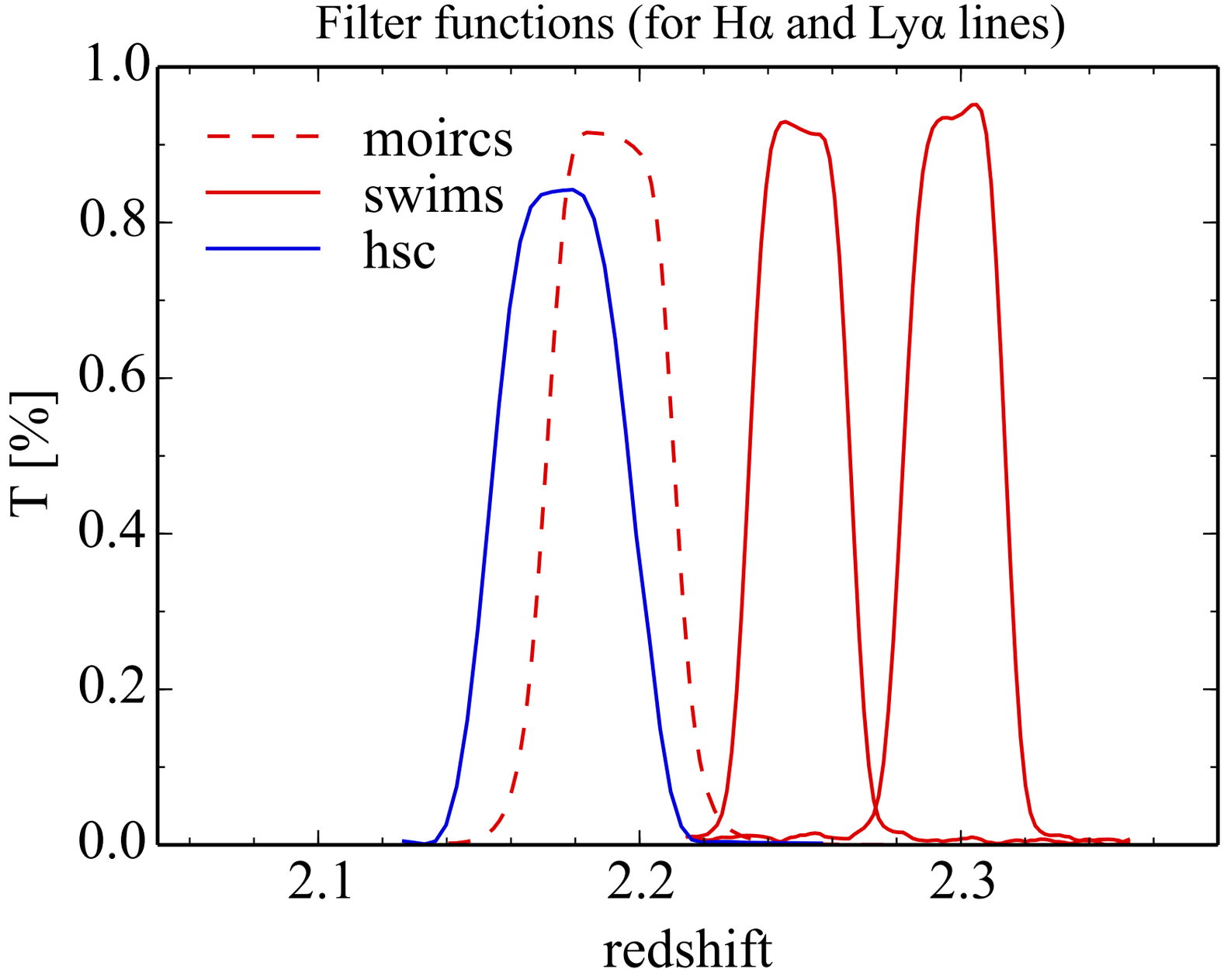
It provides us with unique results regarding environmental dependence of galaxy formation/evolution on number density & cold gas density

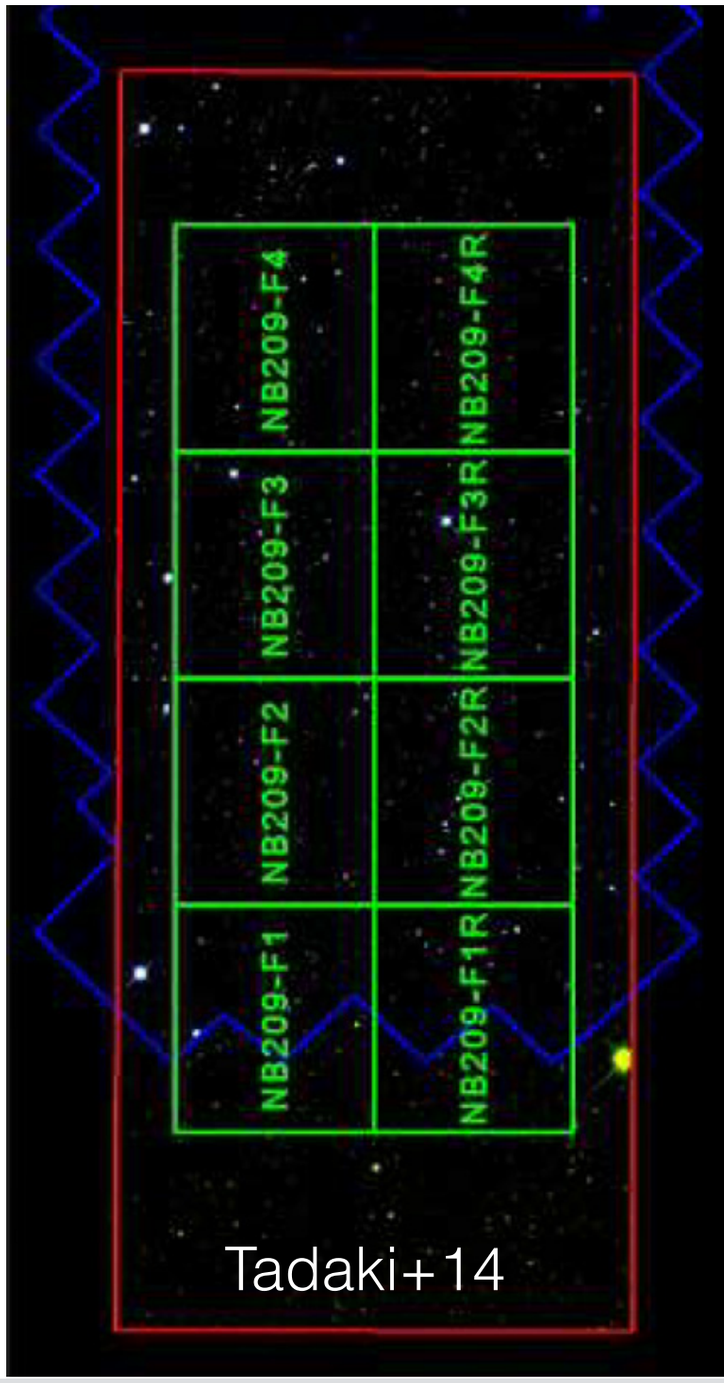
Strong points

- Combination of NB filters by HSC & SWIMS provides statistical sample
- SWIMS/TAO can conduct large intensive programs
- Wide wavelength coverage of SWIMS is suitable for z confirmation (z~2)

Proposed fields

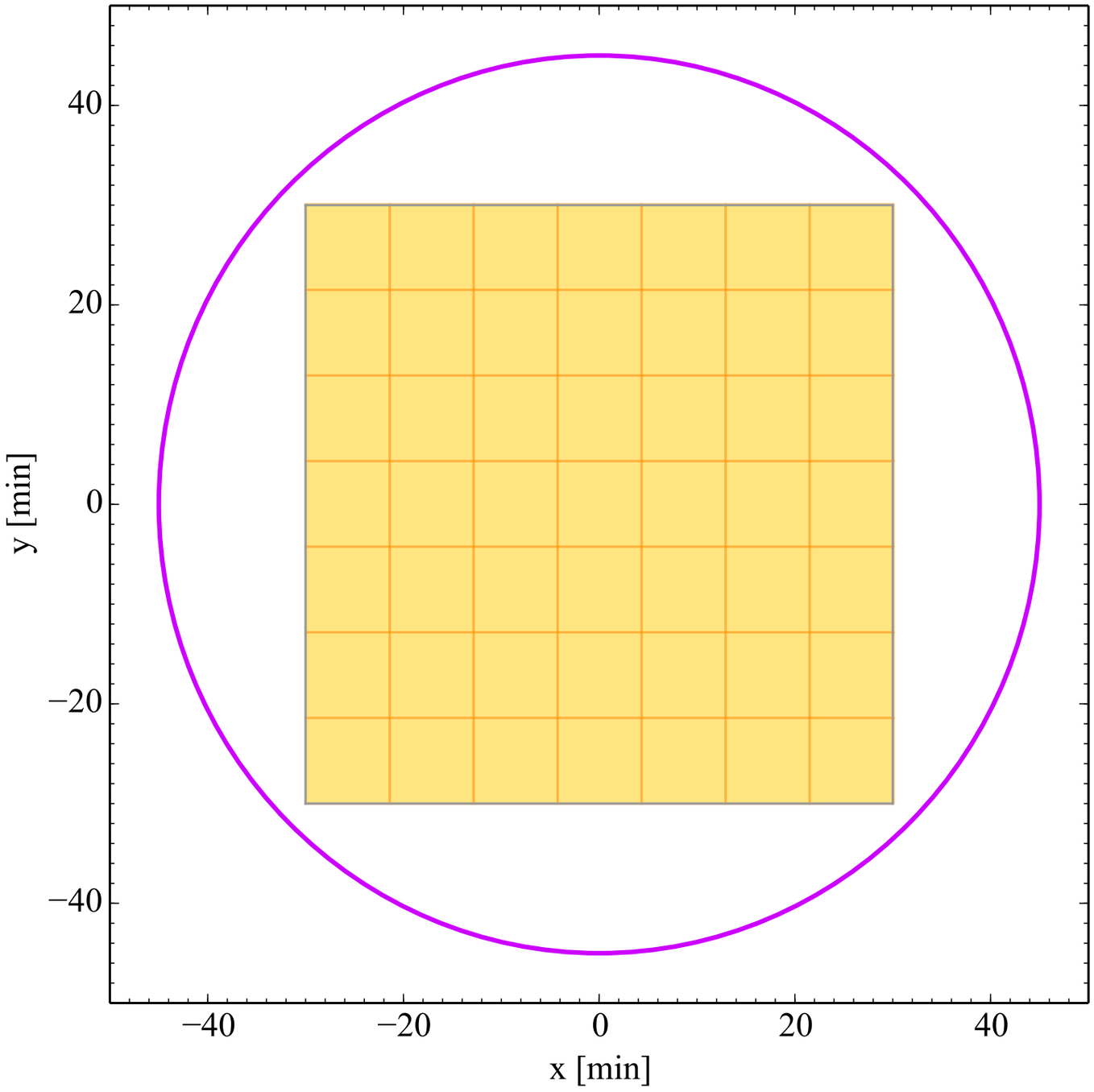
COSMOS (ACS, MB/Scam&ZFOURGE, overlapping with CLAMATO) or SXDS
Redshift ~2.2 is preferred since SWIMS/TAO covers Hα line at z<2.8 (λ>B1000)
We have NB2095 data taken by MOIRCS in SXDS-CANDELS field (Tadaki+14)
I may be able to purchase an additional NB filter for SWIMS





Proposed survey - Plan A (sounds too expensive)

1. Subaru pilot NB2137/2167 & Spec. survey for SXDS-CANDELS (~10nights)
2. TAO ultra-wide NIR imaging survey of COSMOS or SXDS filed (1 deg^2)
3. Simultaneously, we also conduct spectroscopic surveys with Subaru & TAO



HSC 1 FoV (90' diameter)
SWIMS/TAO 49 pointing

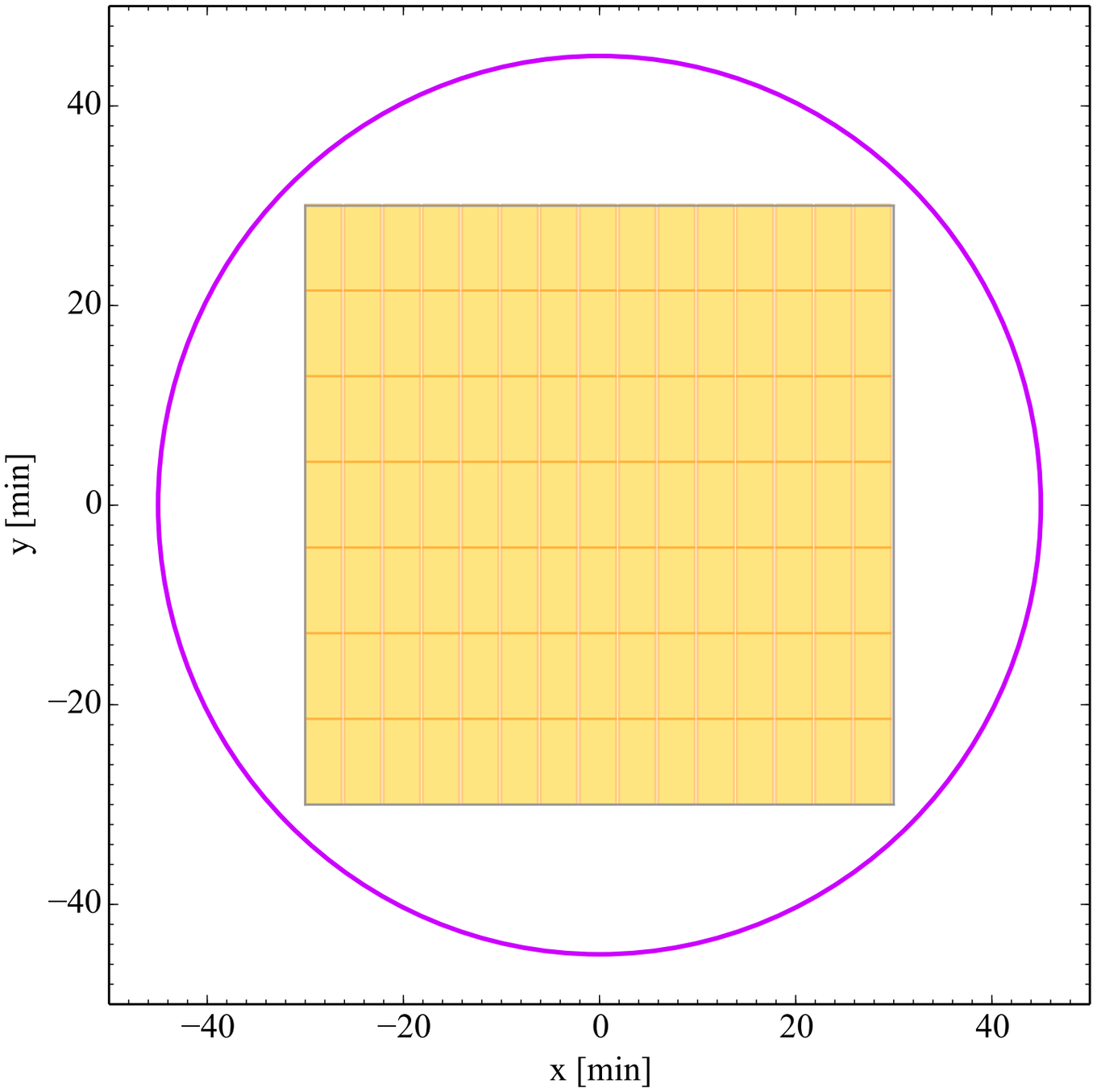
x 3 NB filters
147 Pointing
3 hrs exposure → ~440 hrs

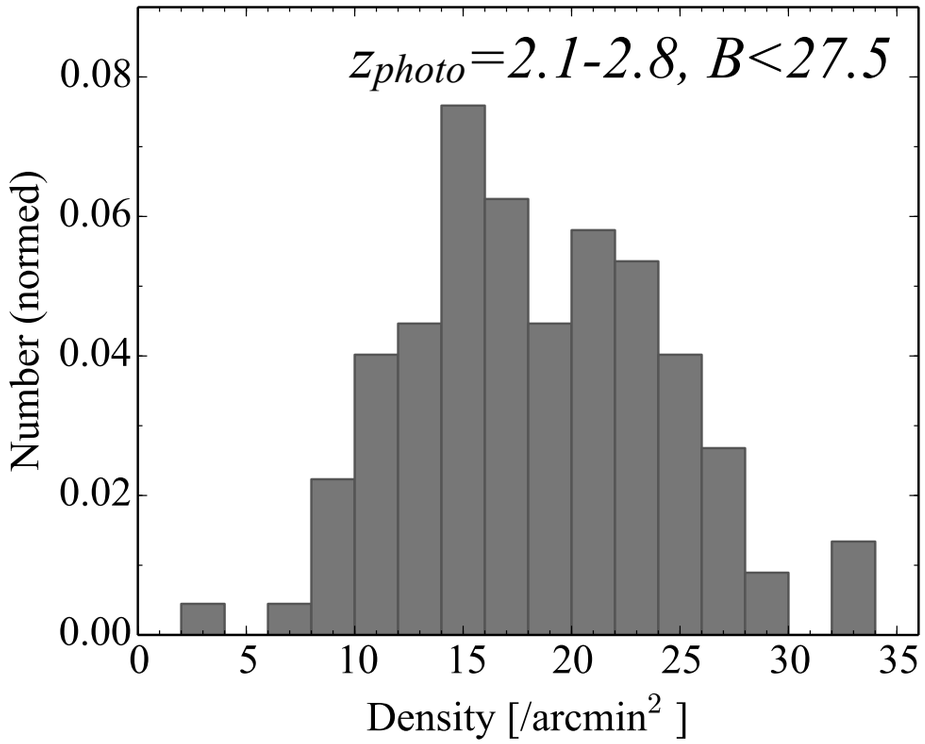
+ ~420 hrs spectroscopy

In total ~120 nights

Proposed survey - Plan B (sounds more effective)

1. Subaru pilot NB2137/2167 and/or Spec. survey for SXDS-CANDELS (~10nights)
2. TAO 1 deg^2 spectroscopic survey of COSMOS or SXDS (B-mag limit <27.5)
<- Wide λ coverage of SWIMS/TAO can detect Hα&[OIII]&[OII] at z<2.8 !!!





HSC 1 FoV (90' diameter)
SWIMS/TAO 105 pointing

4 hrs exposure for each→ ~420 hrs
+observe twice in a part of field (x1.5)

In total ~90 nights

Scientific goals

1. **3D mapping of SFGs and cold gas**
2. Resolving velocity & spatial connections between SFGs and cold gas
3. Relationships between cold gas density and galactic physical properties

Observational requirements

1. The large number of spec-z confirmations at z=2.2-2.8
   which only can be achieved by SWIMS/TAO
2. Good target selection (i.e. accurate photometric redshift)
   collaboration with ZFOURGE should work better
3. Collaboration with Ouchi-san's team (holder of pair NB filters with HSC)

We should challenge this kind of study before the TMT/ELT era