Comparison of global physical properties between Hα and [OIII] emitters at z=2.23

– towards emission line galaxy survey at z > 3 by SWIMS-18

Tomoko Suzuki (Sokendai/NAOJ)

Collaborators :
T. Kodama, D. Sobral, I. Tanaka, M. Hayashi, Y. Koyama, K. Tadaki, Y. Minowa, R. Shimakawa, and M. Yamamoto

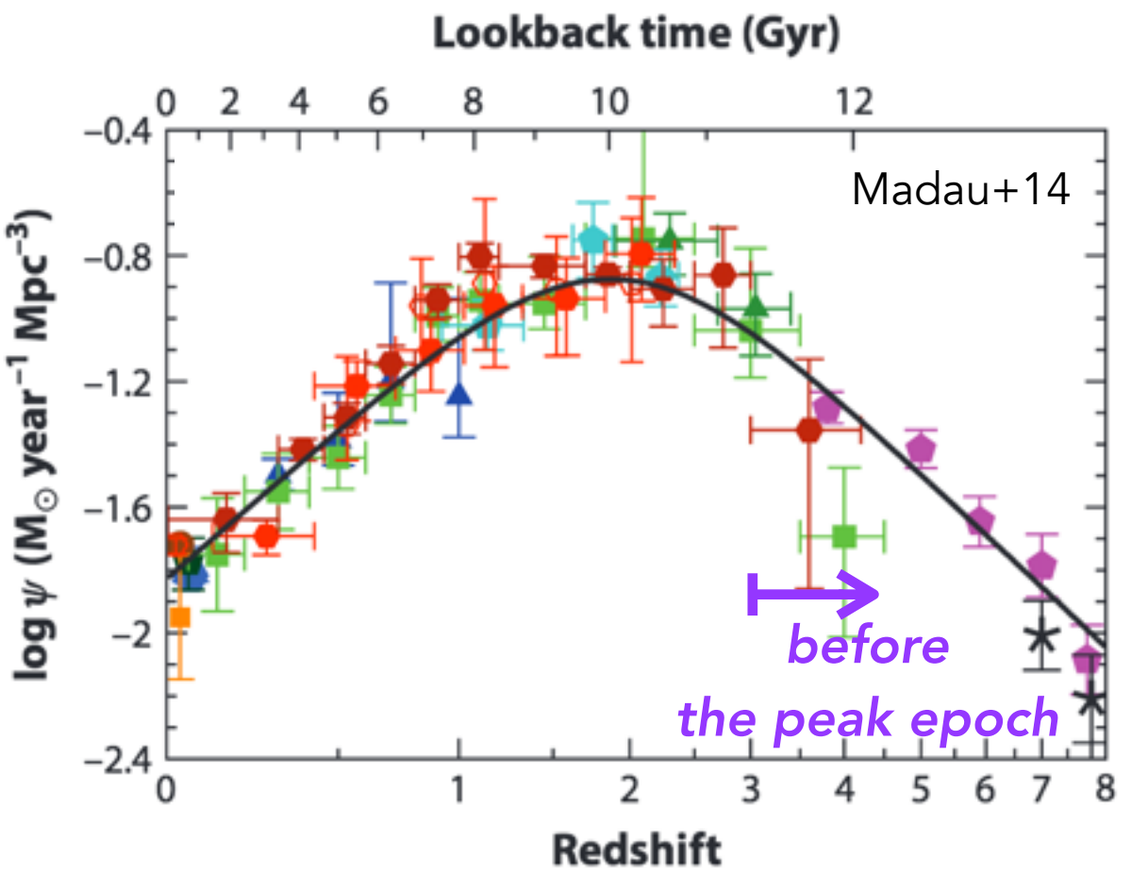
Background

Emission line galaxy survey at z > 3

- Before the peak epoch of galaxy formation at z~2–3.

- Key epoch to reveal how galaxies have evolved towards the peak epoch

- Hα is not available ⇒ need to use other emission lines; [OIII], Hβ, and [OII] for z > 3



▼ SWIMS-18 Target redshift for each emission

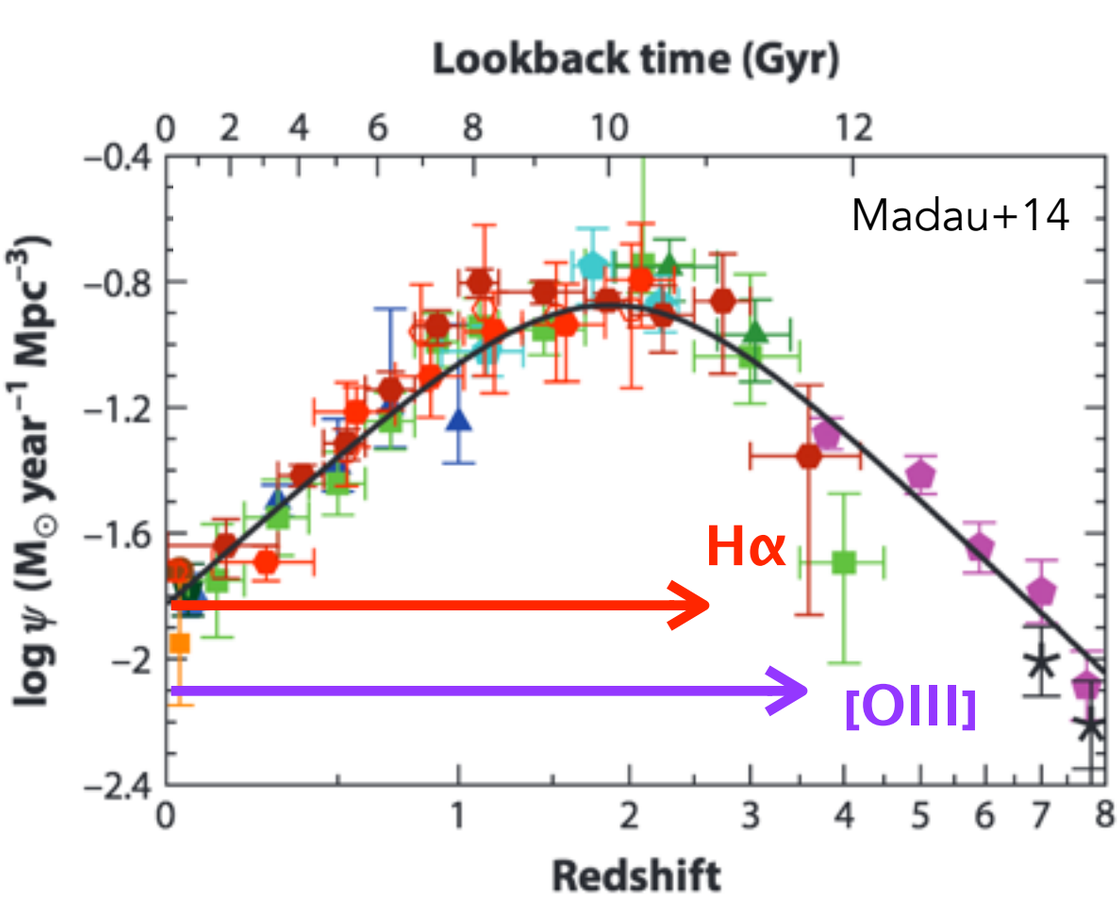
NB filters	λ_c (μm)	FWHM (μm)	z(Hα) 6563Å	z([OIII]) 5007Å	z(Hβ) 4861Å	z([OII]) 3727Å
NB1244	1.244	0.012	0.895	*1.484*	1.559	2.337
NB1261	1.261	0.012	0.922	*1.519*	1.595	2.384
NB1630	1.630	0.016	*1.484*	*2.256*	2.354	3.374
NB1653	1.653	0.016	*1.519*	*2.302*	2.401	3.436
NB2137	2.137	0.021	*2.256*	3.268	3.396	4.734
NB2167	2.167	0.021	*2.302*	3.328	3.458	4.814

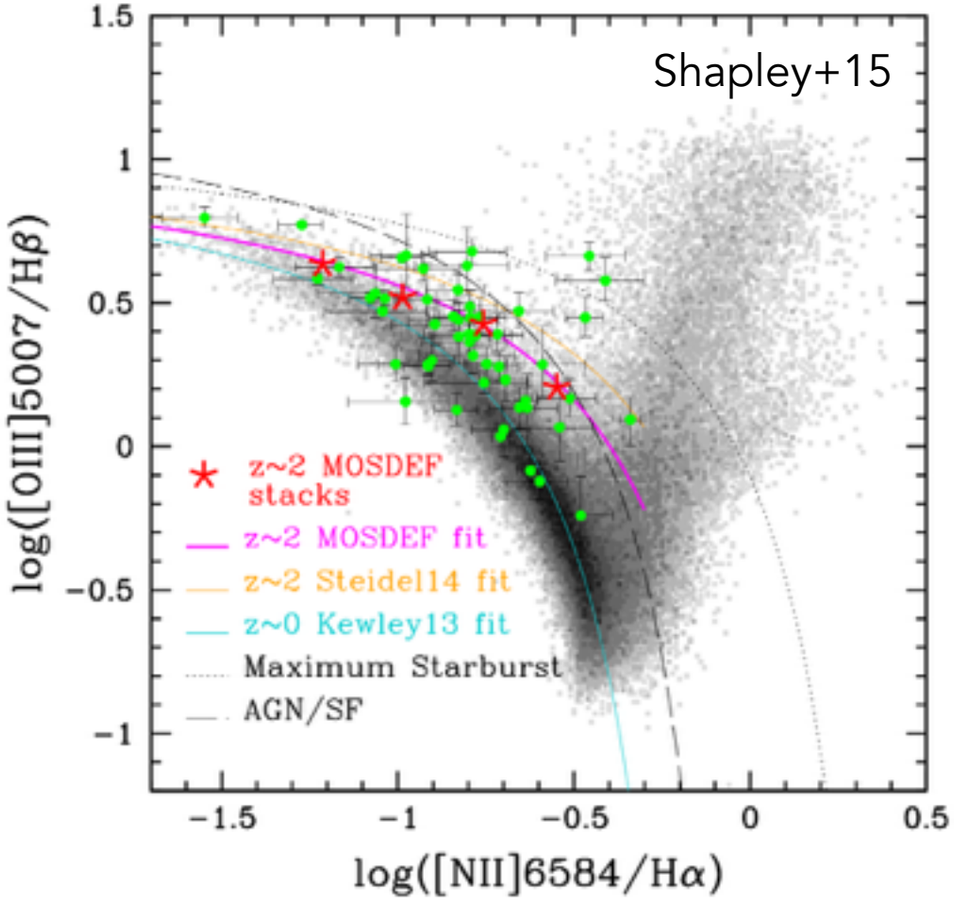
Strong [OIII] emission at high redshift

- High-z star-forming galaxies have stronger [OIII] emission (e.g. Steidel+14; Shapley+15)
  : due to higher sSFR and/or lower metallicity

- Less sensitive to dust extinction than UV.

⇒ [OIII] emission can be used as a good tracer of star-forming galaxies at high redshift ??

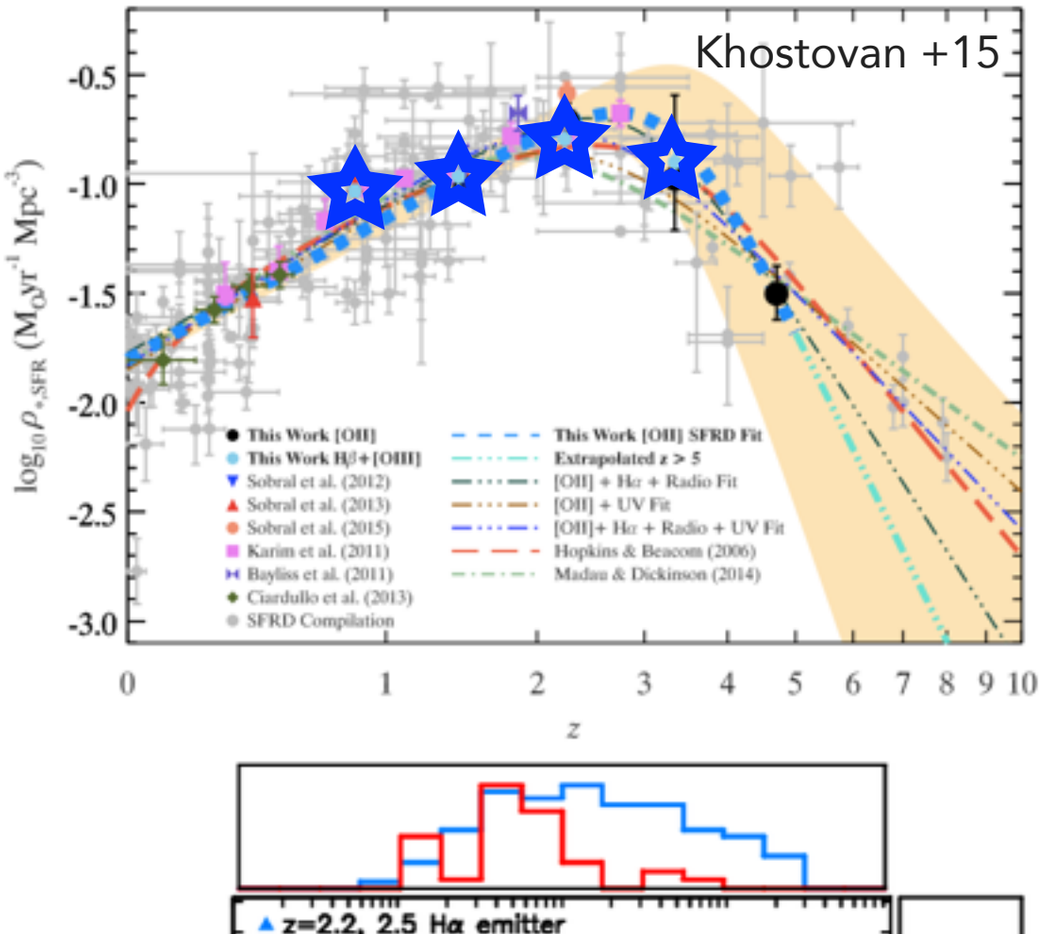




[OIII] emitters at z > 3

[OIII] emitter sample at z>3 has been constructed by NB imaging survey.

e.g. (field) Khostovan +15, TS+15
(protocluster) Maschietto+08

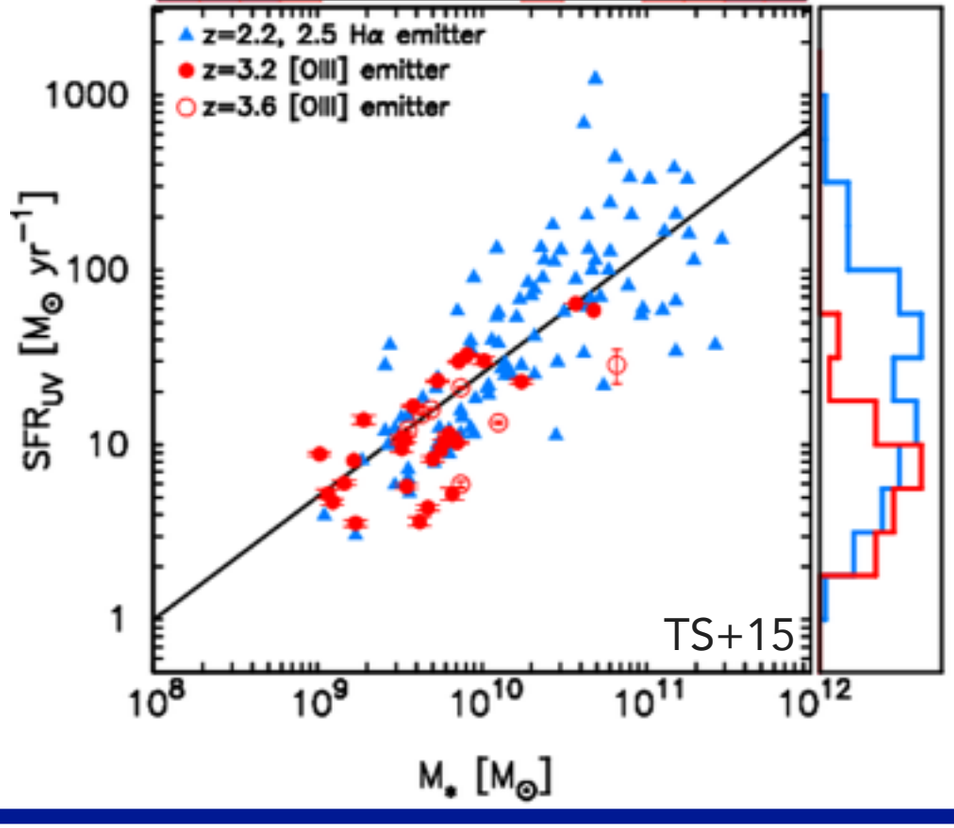


▶ Mahalo-Subaru sample @ SXDF
: Offset on the $M_\star$ vs SFR diagram

between [OIII] emitters and Hα emitters

⇒ reflect the evolution of galaxies from z > 3

or selection effects by using [OIII] line ??



[OIII] emission line as a tracer of star-forming galaxies??

Possible biases by using [OIII] as a tracer of star-forming galaxies

- AGN
- lower metallicity
- higher ionization state

⇒ Towards the emission line survey at z > 3 by SWIMS-18,
it is necessary to understand what galaxy population is traces by [OIII] emitters at high redshift.

We use the Hα and [OIII] emitter samples at z=2.23 obtained through HiZELS, and compare the global physical properties between the two populations.

→ Are there any differences of physical properties between galaxies selected by [OIII] and Hα ??

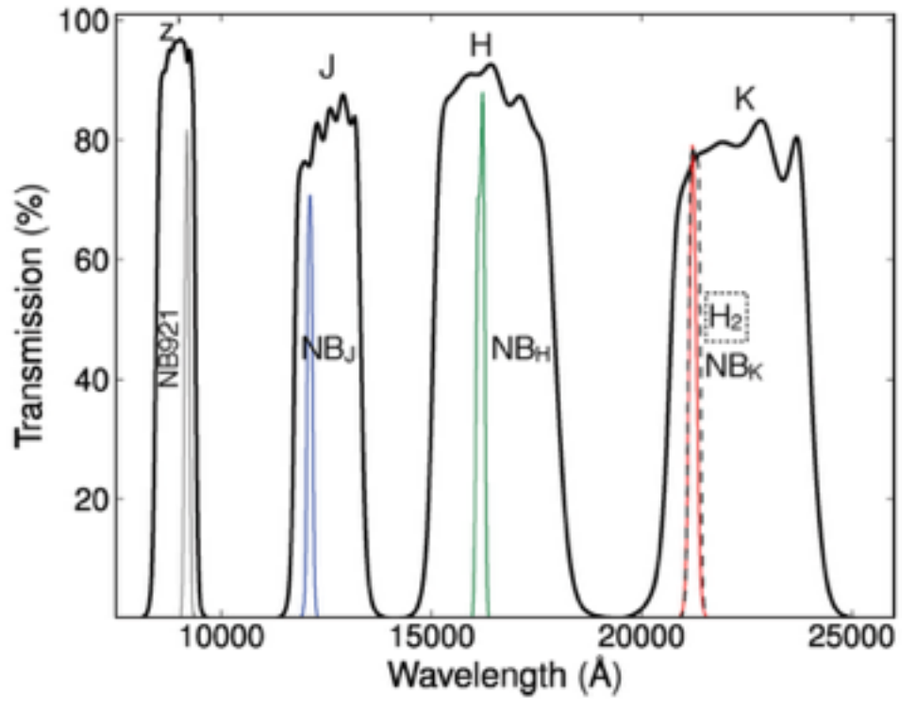
Emission line galaxy survey by HiZELS

◎ NB filter

	λc (μm)	FWHM (Å)	redshift
NB	1.617	211	2.23 ([OIII])
NB	2.121	210	2.23 (Hα)

→ We can obtain [OIII] + Hα dual emitter sample at z=2.23

Sobral + 2013



◎ Survey field : ~ 1.6 deg^2 in the COSMOS field

◎ NB emitter criteria : $\Sigma > 3$, $EW_0 = 25$Å

◎ 3sigma limiting magnitude and flux limit (average)

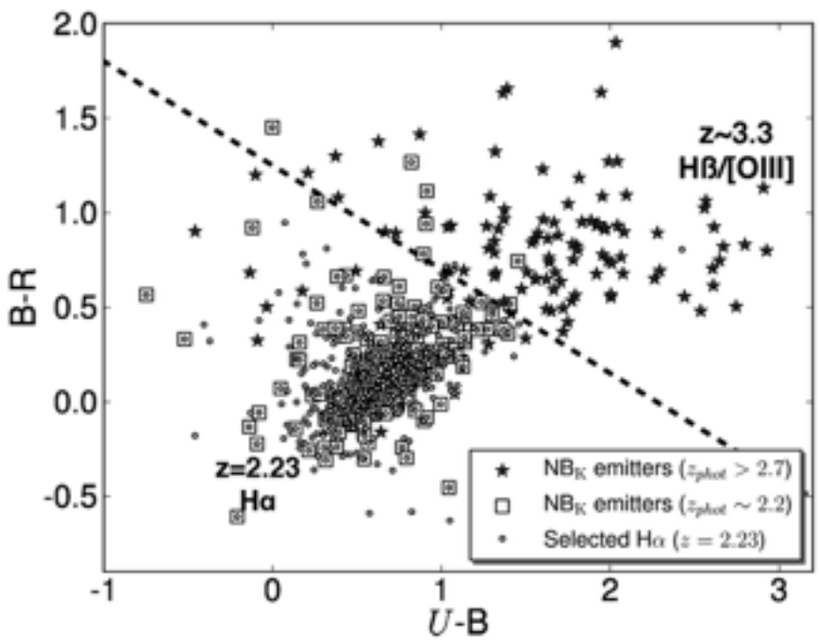
NB_H : 22.31 mag(AB) / Flim = 1.1×10^{-16} (cgs)

NB_K : 22.71 mag(AB) / Flim = 4.5×10^{-17} (cgs)

◎ Redshift separation : photo-z + color selection

- *izK* and *UVz* for NB_H
- *BzK* and *UBR* for NB_K

▼ *UBR* selection from Sobral+2013



Hα and [OIII] emitter samples at z=2.23

- Detected with only Hα : 427 objects

- Detected with only [OIII] : 141 objects

- Detected with Hα and [OIII] : 86 objects (redshift is almost confirmed)

◎ Possible contamination of [OIII] λ5007 emitters

- [OIII] λ4959
- Hβ (4861Å)

: cannot separate by photo-z and color selection

Assuming the line ratio :

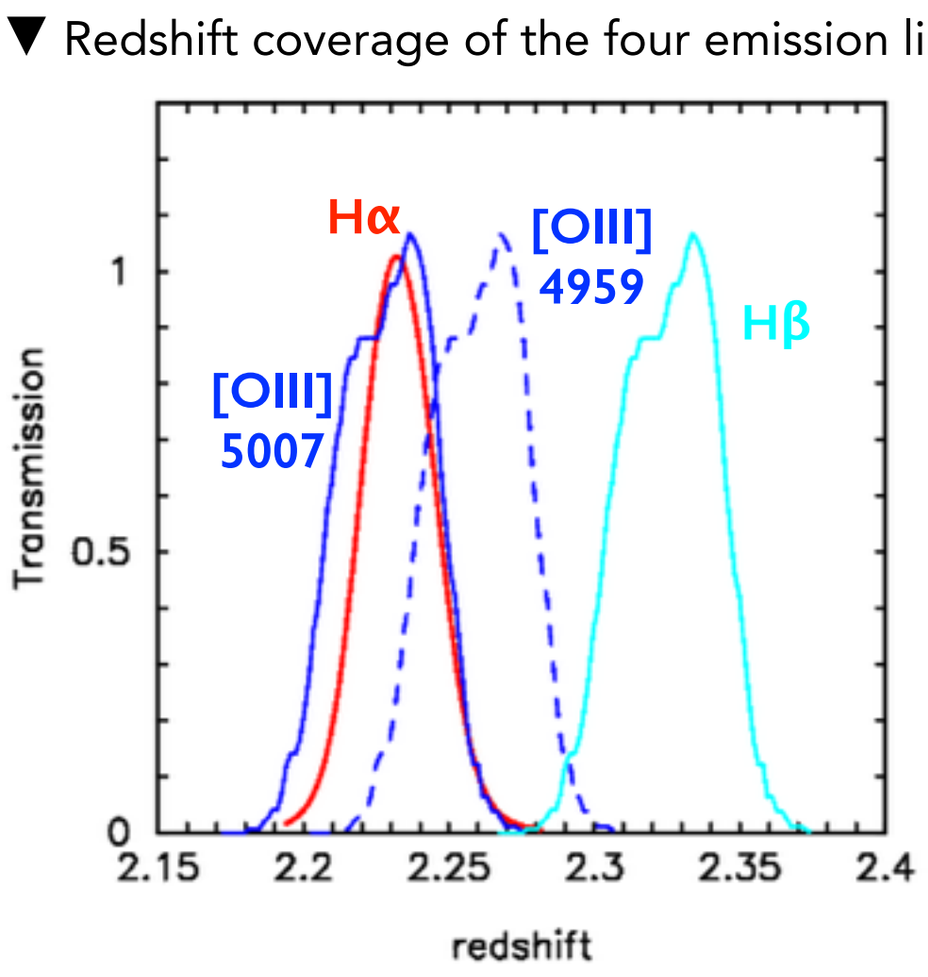
[OIII] λ5007 / [OIII] λ4959 = 3.0

[OIII] λ5007 / Hβ = 5.0

the expected contribution of both emitters is < 10 %

⇒ contribution is small

▼ Redshift coverage of the four emission lines



Global physical quantities

Comparison between three samples

- Stellar mass : estimated by SED fitting (BC03, Salpeter IMF, declining SFH)

- SFR from UV luminosity (based on Madau+98)

- Dust extinction @ FUV : based on UV slope (based on Heinis+13)

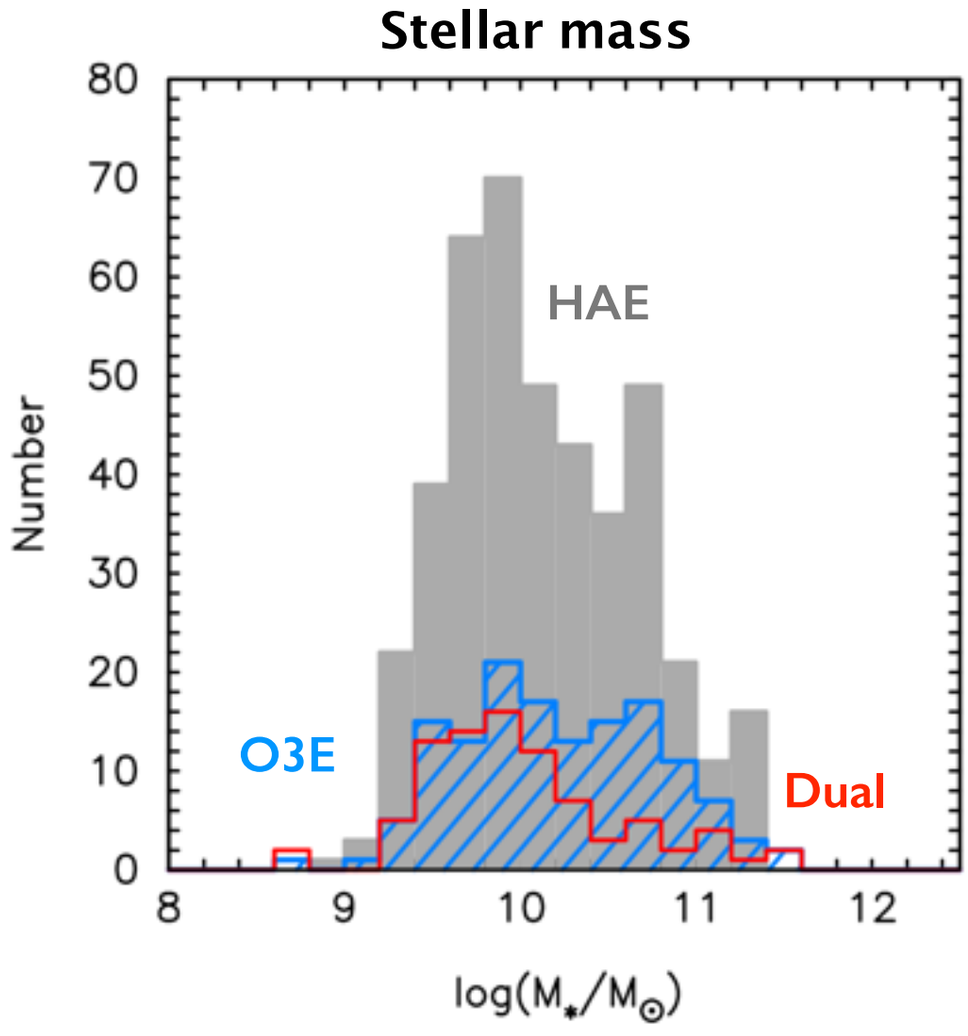
▶ stellar mass distribution :

KS-test p-value

HAE and O3E / HAE and dual
/ O3E and dual

⇒ All the three samples are drawn from

the same parent population.



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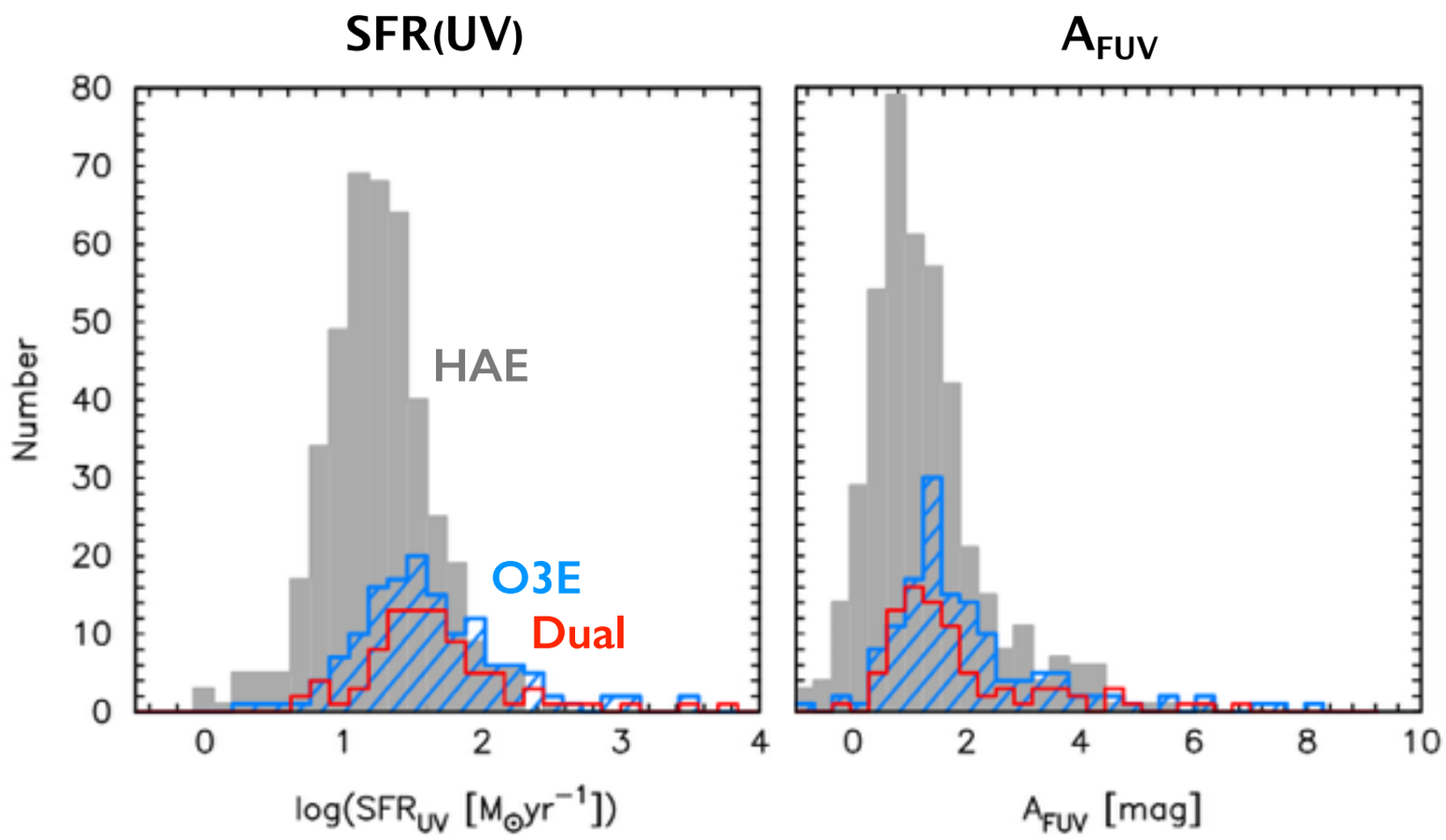
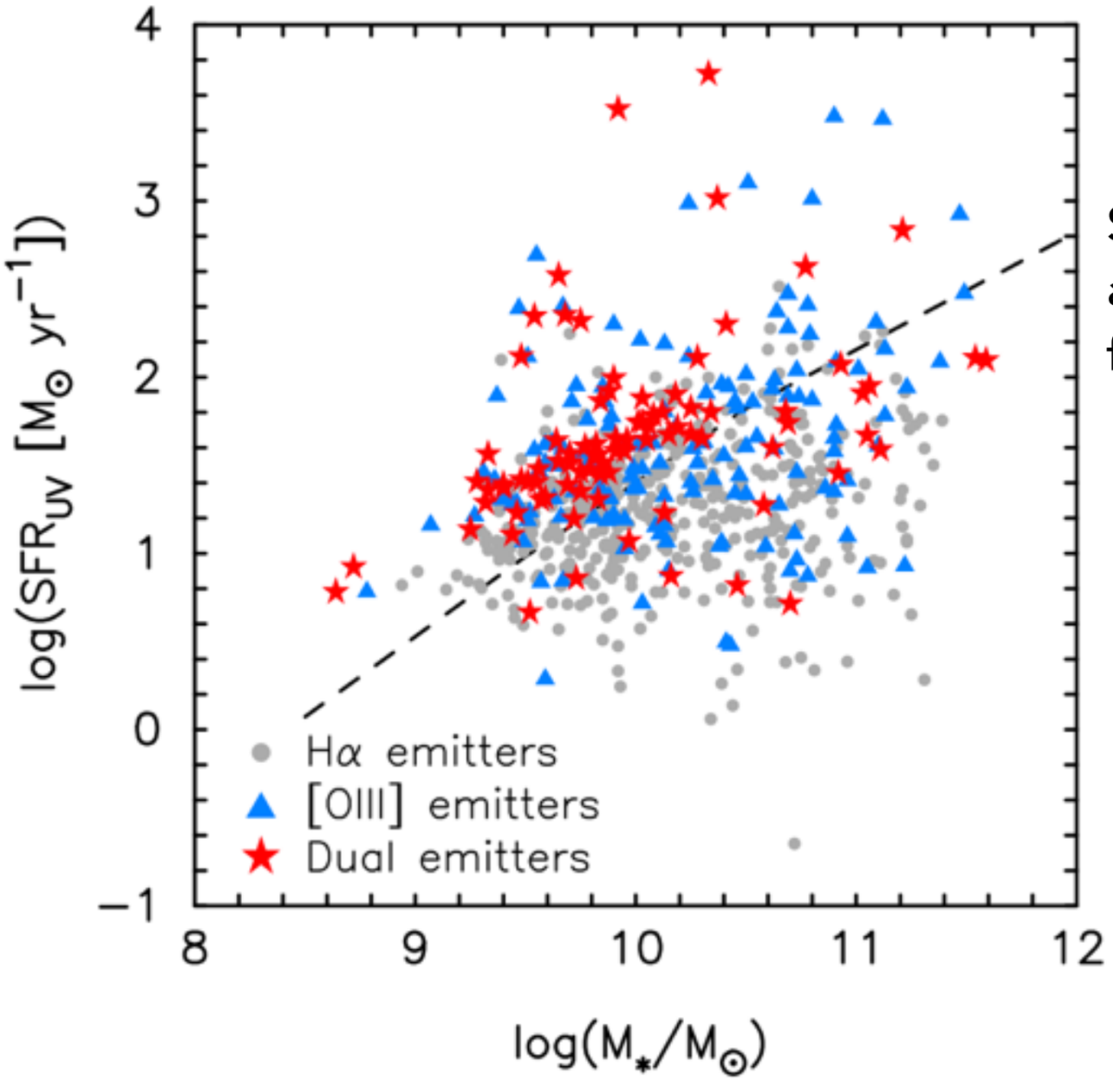
▶ SFR and A_{FUV} distribution

: maybe affected by difference of the flux limit between H and K band.



Comparison on the $M_\star$-SFR diagram

No large systematic difference on the main sequence diagram



Star-forming main sequence
at 2.0 < z < 2.5
from Whitaker + 14

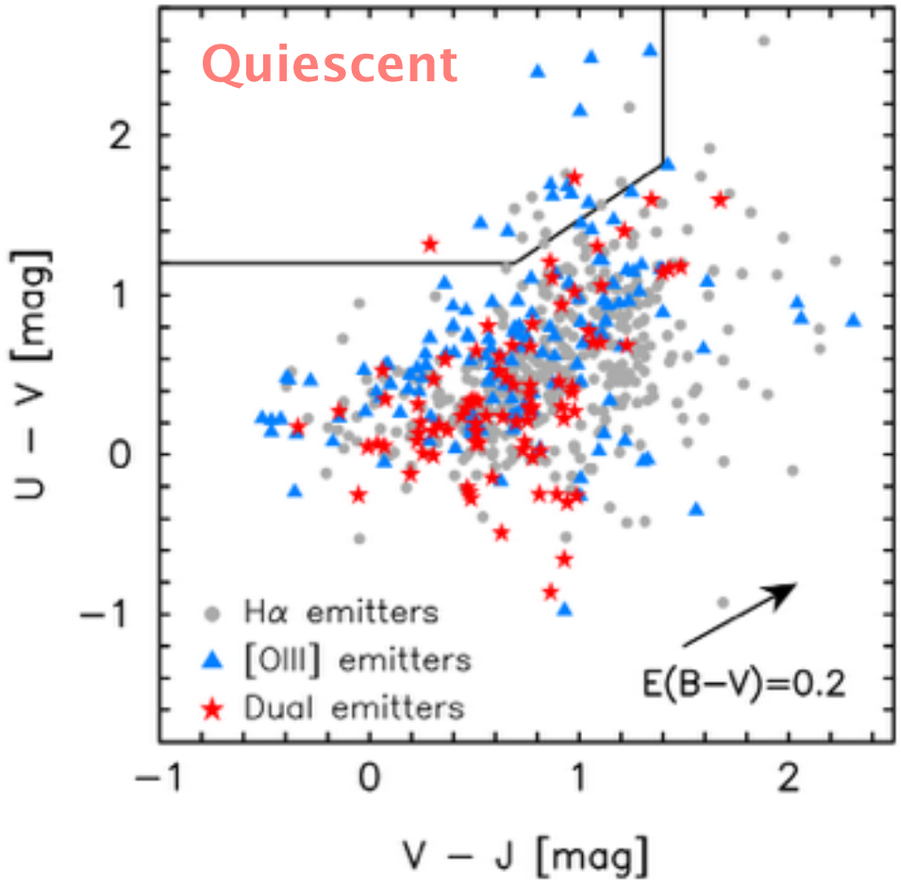
Contribution of AGNs ??

▶ rest-frame UVJ diagram

- separate quiescent galaxies and
  young, dusty, star-forming galaxies

Some objects are classified as quiescent galaxies.
⇒ Quiescent galaxies with line emission

: Emission line is dominated by AGN activity.



★ Fraction of objects classified as quiescent galaxies

Hα emitters : 2%
[OIII] emitters : 8% → slightly biased to AGN??
Dual : 2%

: But fraction is not so large…

※ We cannot mention the fraction of the galaxies contributed by AGN and star formation

[OIII] emission line as a tracer of star-forming galaxies

: [OIII] emitters do not show large systematic differences as compared to Hα emitters at z ~ 2.

⇒ [OIII] can be used as a tracer of star-forming galaxies.

SWIMS-18 survey :

★ Larger sample in the general field

★ Emitter sample in high density region

⇒ [OIII] emitter search in protocluster fields at z > 3

- Number of NB surveys in protocluster fields at z > 3 is small…

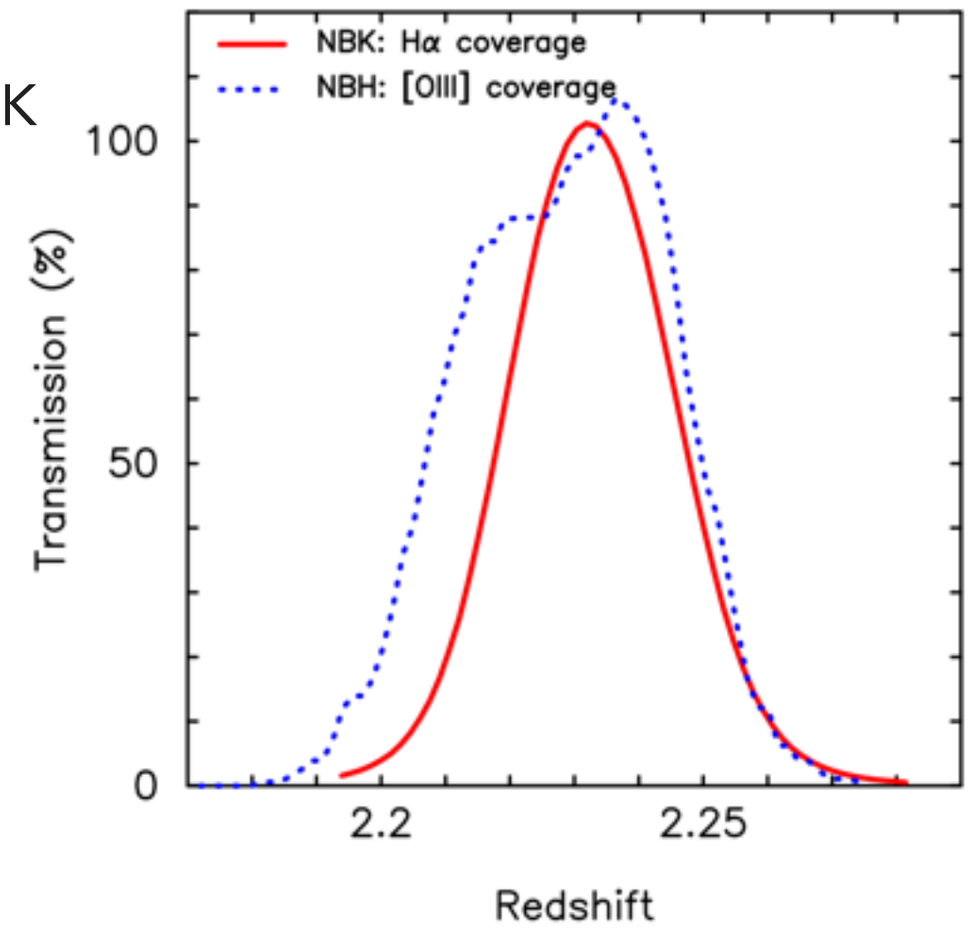
★ Follow-up spectroscopy is important for their detailed physical properties.

Investigate the excitation states of star-forming galaxies at z > 3
with [OIII], Hβ, and [OII].

Dual emitter survey by SWIMS-18

▶ NB filters of HiZELS
: Different response curve between NBH and NBK

⇒ cannot obtain accurate Hα/[OIII] ratio



⇒ With pair NB filter of SWIMS-18,

we can estimate the line ratio of dual emitters.

★ Relation between Hα/[OIII] ratio and stellar mass

→ Discuss the excitation states for star-forming galaxies at z~ 1.5–2.3
only by imaging observation.

Summary

Towards the emission line galaxy survey at z > 3 by SWIMS-18,
we compare global physical properties between Hα and [OIII] emitters at z=2.23
in order to investigate the relation of the two galaxy samples.
We construct three galaxy samples; Hα emitters, [OIII] emitters, and Hα + [OIII] dual emitters using NB imaging data from HiZELS.

◎ Comparing the global physical properties, the stellar mass distributions of three samples are statistically same with each other.

◎ On the stellar mass - SFR diagram, there is no large offset between them.

◎ [OIII] emission line can be used as a indicator of star-forming galaxies at high-z.

Through SWIMS-18 survey, we will obtain larger [OIII] emitter sample at z > 3 across the various environments. This enables us to investigate the star-forming actives of galaxies and its environmental dependence before the peak epoch.