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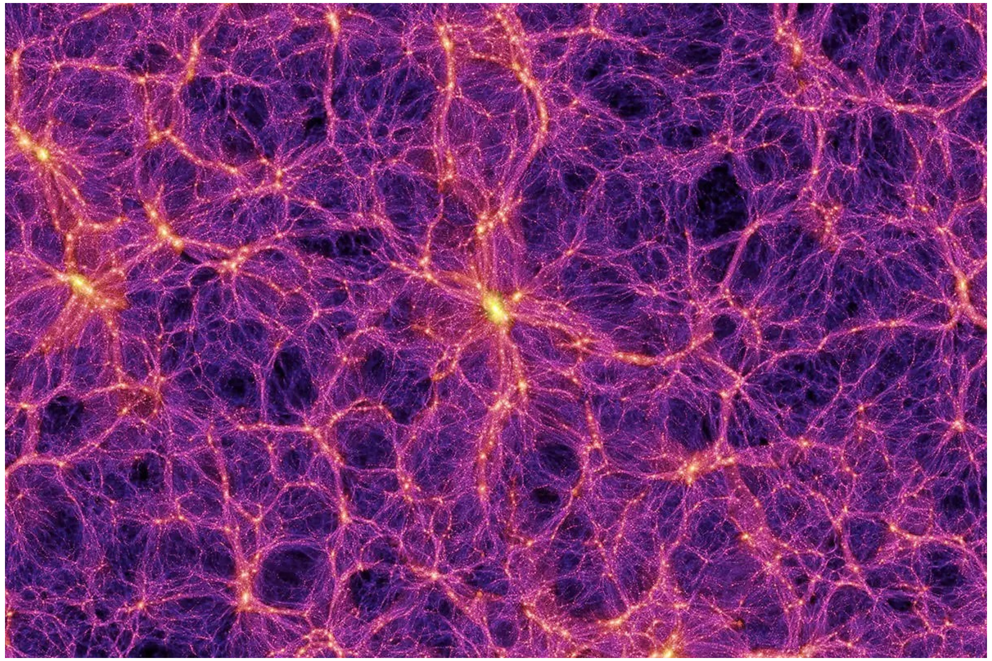
Environmental dependence of star forming galaxies at z~0.4 in the DEEP2-3 Field

Ronaldo Laishram
D2, Tohoku University, Japan

Ronaldo Laishram[1], Tadayuki Kodama[1], Yusei Koyama(NAOJ) , José Perez[1,]

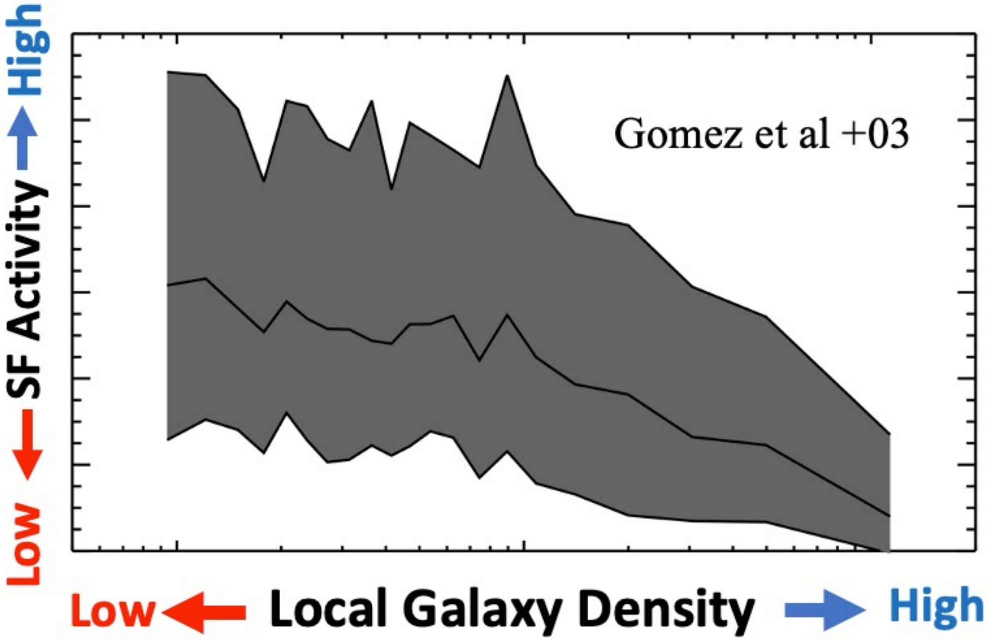
INTRODUCTION

Large-scale structures



Springel 2005

Environment dependence at z~0



Understanding precisely how galaxies change their properties as a result of the hierarchical growth of LSSs

At high redshift ?

How or why? *What makes this environmental dependence ?*

When? *epoch/timescale for the emergence of the environmental effect?*

Difficulty is the need for accurate determination of the redshift to determine the precise environment of the galaxies.

Spectroscopic redshift:

- ❖ ***Ideal*** but Expensive and Samples will be too numerous to be observed
- ❖ Require pre-selection of spectroscopic targets which can introduce sampling bias

Narrow Band Imaging:

Narrowband filters targeting nebular emission from HII regions of star-forming galaxies.

- ❑ Powerful approach to identify star-forming (SF) galaxies along the cosmic web in the distant universe based on their strong emission lines

Photometric redshift:

- ❖ Easy to get but uncertainty becomes large at higher redshifts

Difficulty is the need for accurate determination of the redshift to determine the precise environment of the galaxies.

Narrow Band Imaging:

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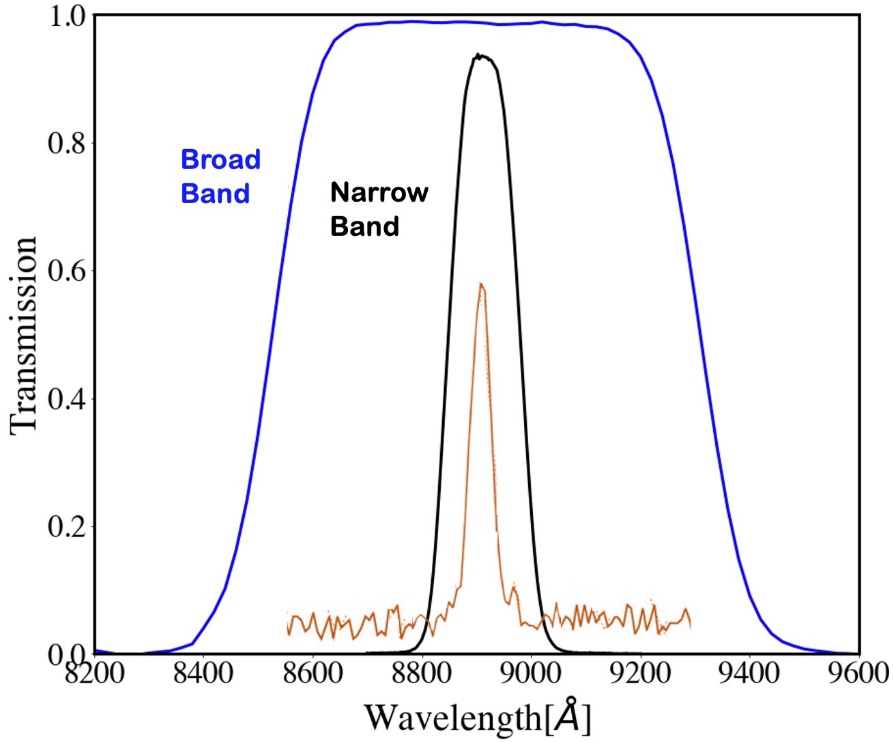
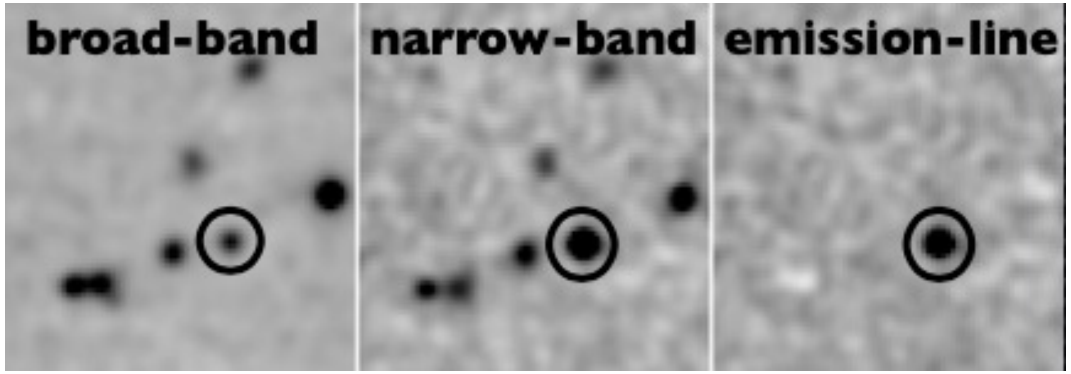
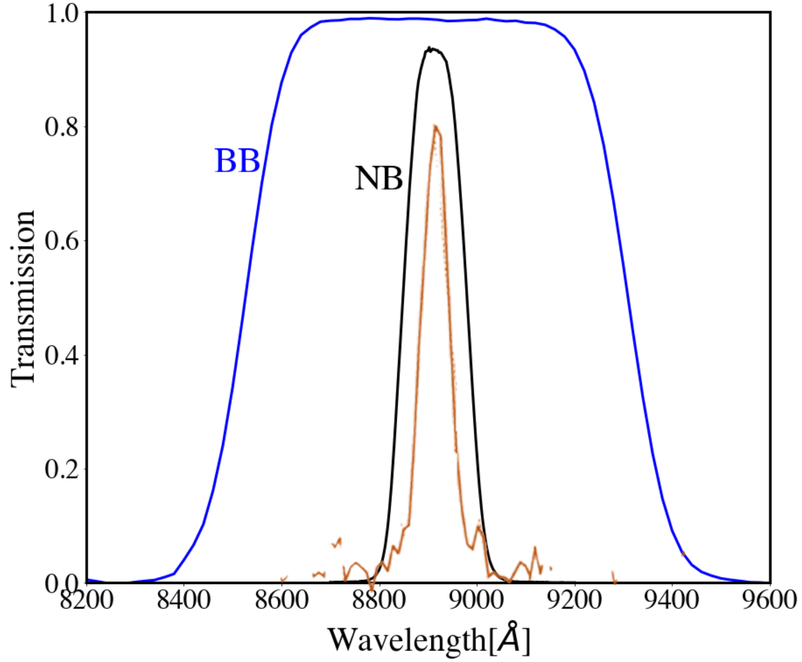




Accuracy of $\Delta z \sim 0.03$

Narrow Band Imaging:

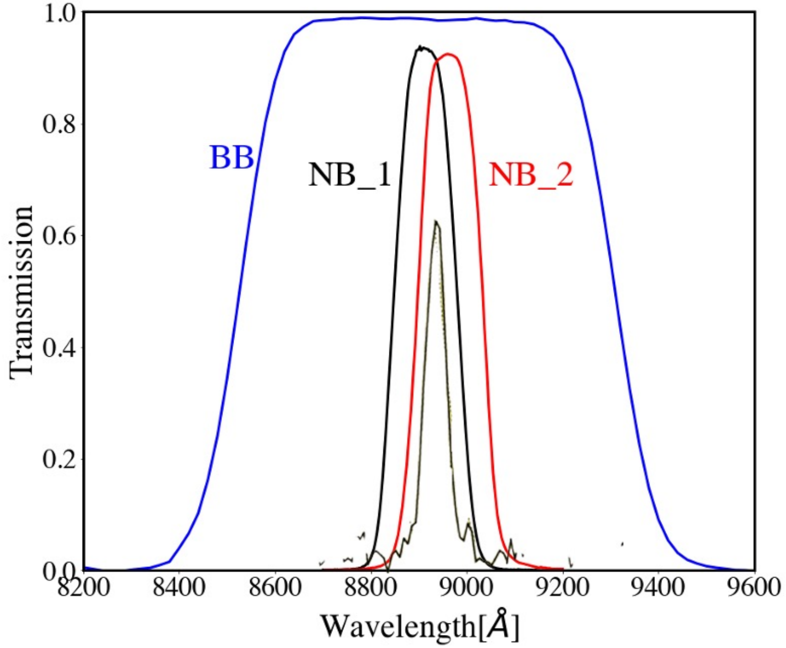


Accuracy of $\Delta z \sim 0.03$

Comoving depth of 56 Mpc at z~1.46

Too uncertain for measuring
Precise Environment

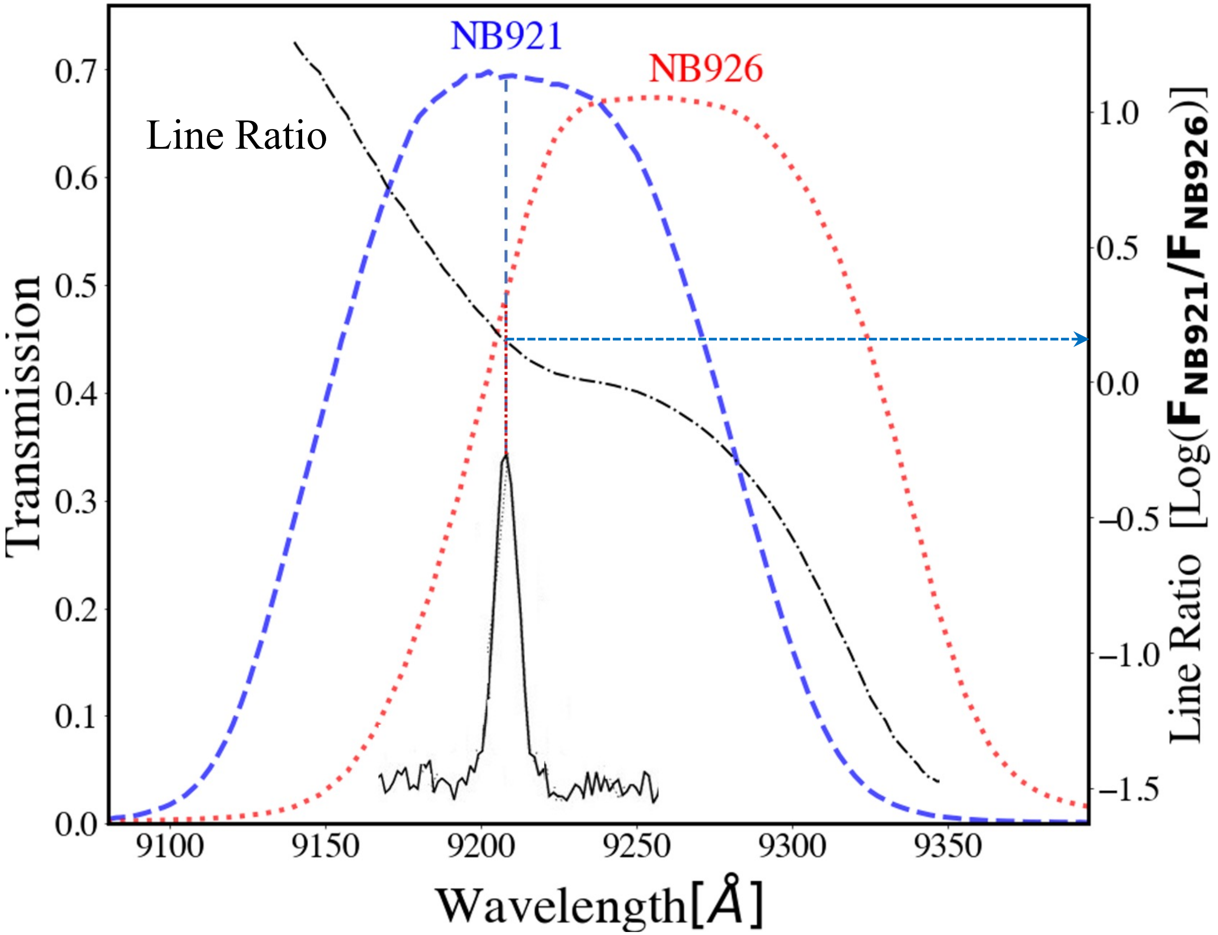
How to solve this?



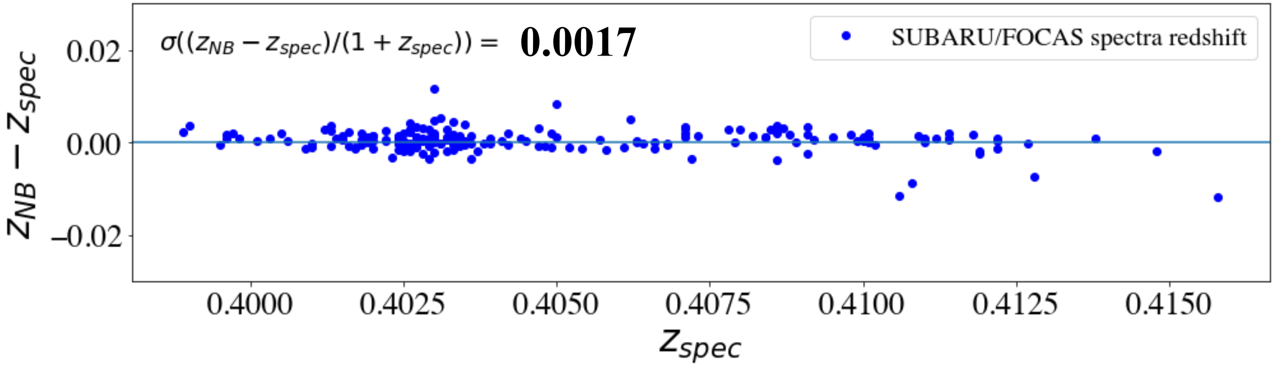
A novel technique to determine accurate redshift and flux using two Narrow-band filters

REDSHIFT MEASUREMENTS WITH TWO ADJACENT NARROW-BAND FILTERS

Laishram et al (in review)



Validating the method using **Hα specz(z~0.4)**



$$\sigma_{\Delta z/(1+z_s)} = 0.012 \ \text{at}\ i^{+}_{AB} < 24 \quad ; z < 1.25$$

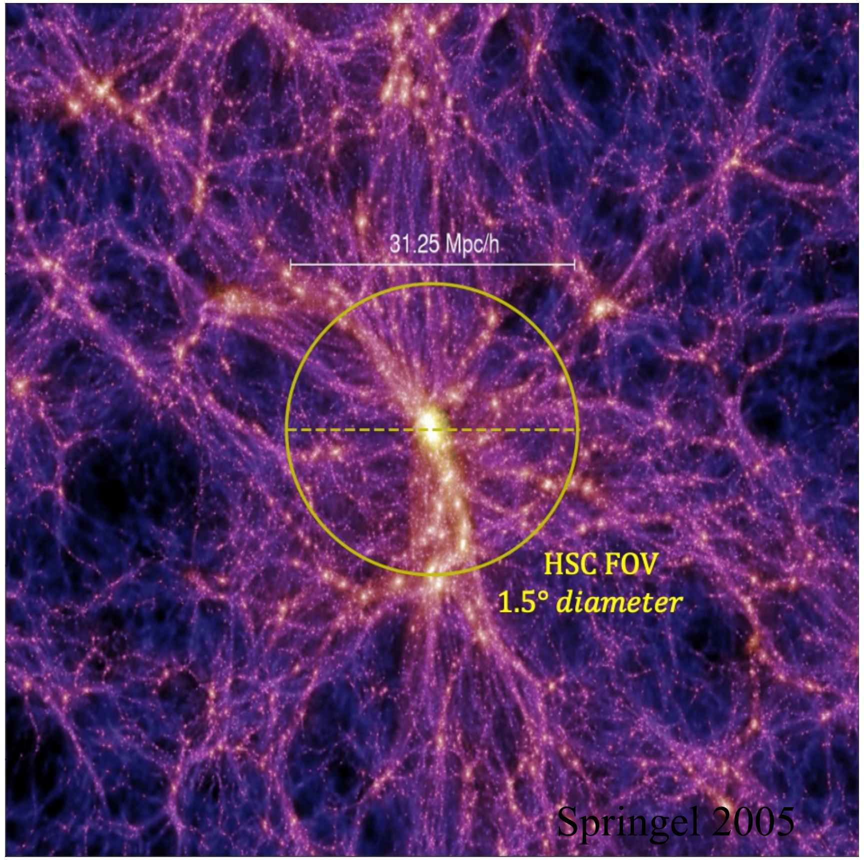
$$\sigma_{\Delta z/(1+z_s)} = 0.06 \ \text{at}\ i^{+}_{AB} \sim 24 \quad ; z \sim 2$$

Photometric redshift comparison; Ilbert et al 2009

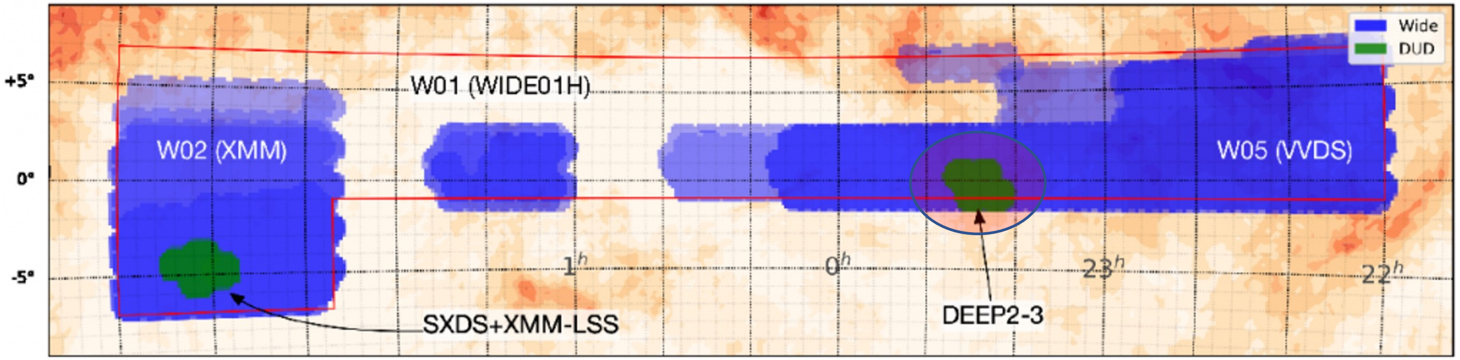
Can measure both accurate fluxes of the emission lines and accurate redshift

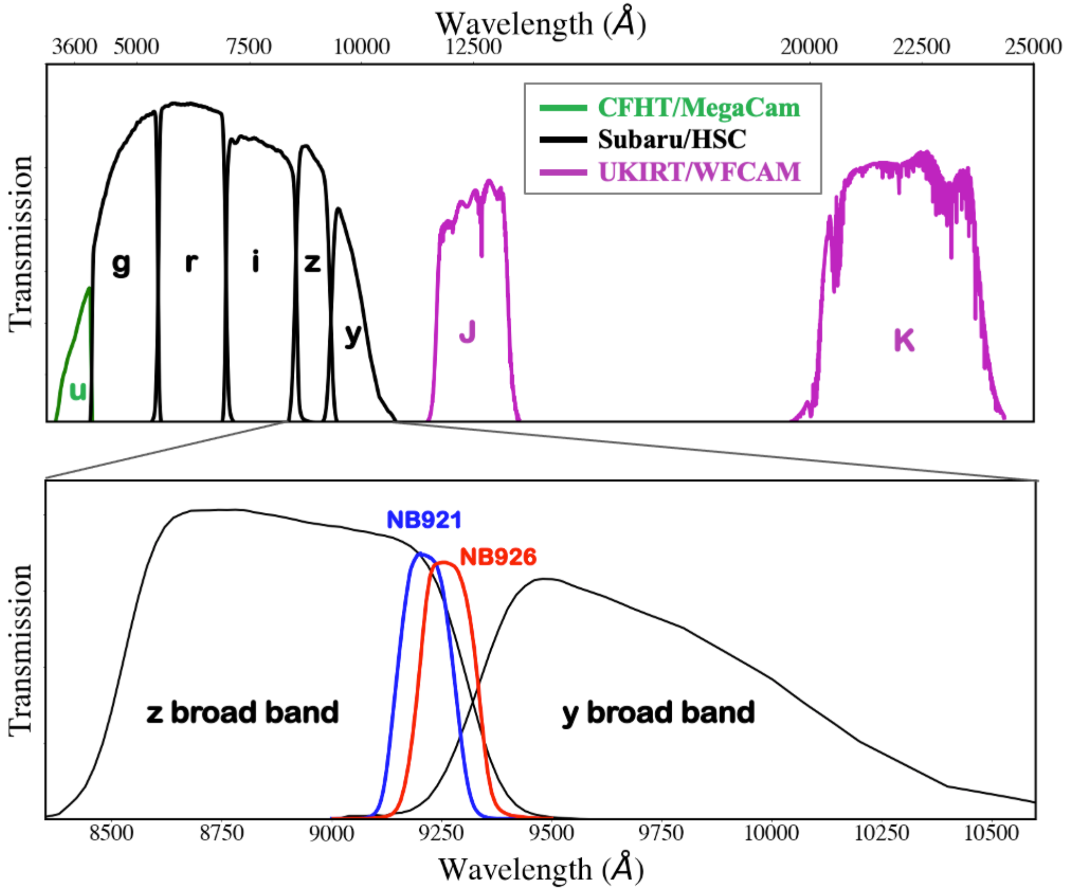
❖ The overlap with a slight difference in the response curves allows us to estimate the redshift based on the difference of emission line fluxes measured in the NB921 and NB926 images.

SAMPLE



Subaru Strategic Program (SSP) with Hyper Suprime-Cam (HSC) provides us with one of the widest and deepest imaging data



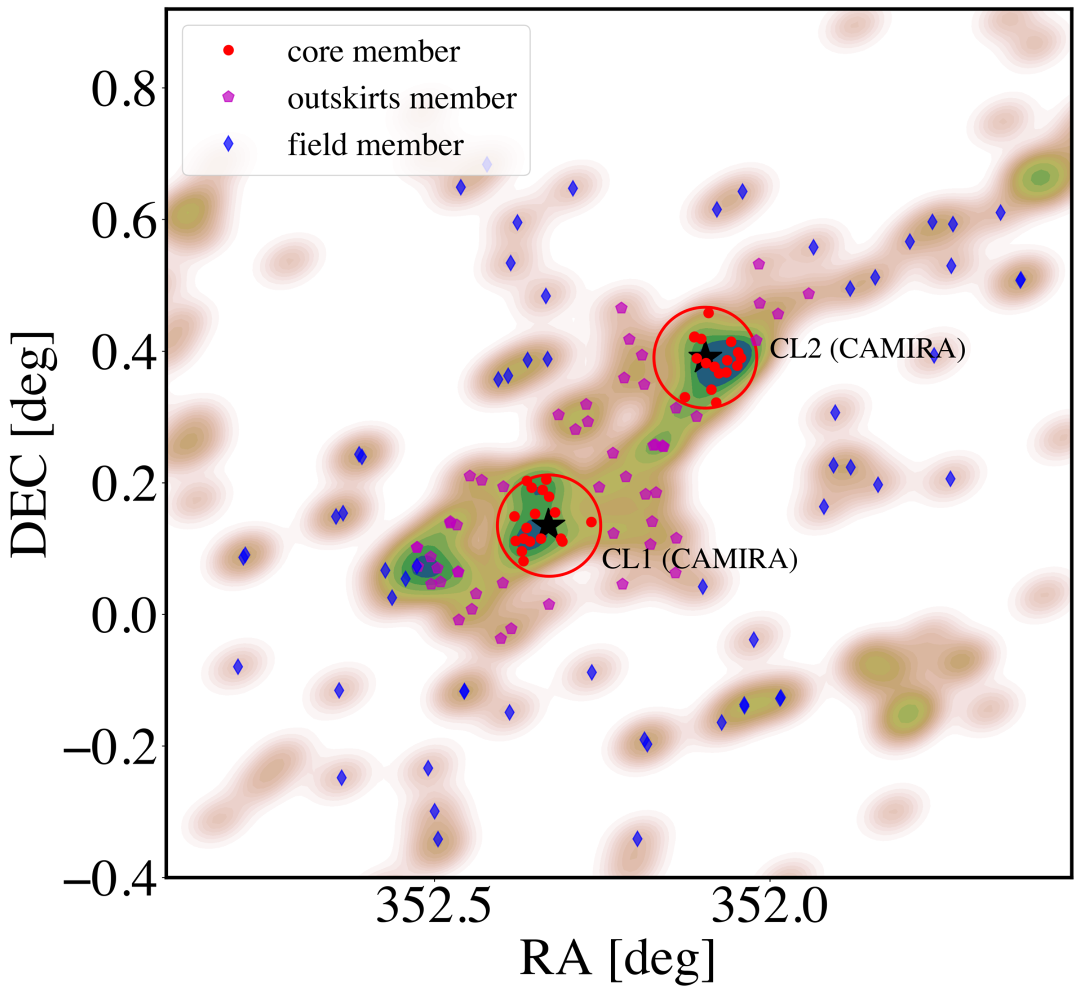


- DEEP 2-3 Field (5.6 deg^2)
- HSC-SSP PDR2 data(Aihara et al. 2019)
  - g, r, i, z, y, NB921
- NB926 (Hayashi et al) (Open-use program S17B)
- CFHT/MegaCam *u*, UKIRT/WFCAM (J,K) DUNES

Hα ~ 0.4

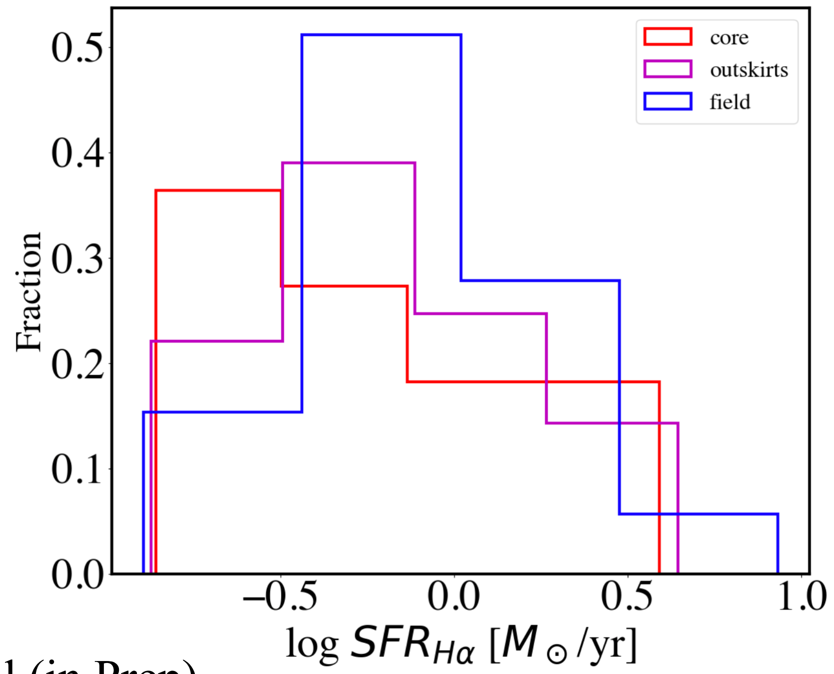
[OII] ~ 1.5

Star forming activities around the CAMIRA Cluster

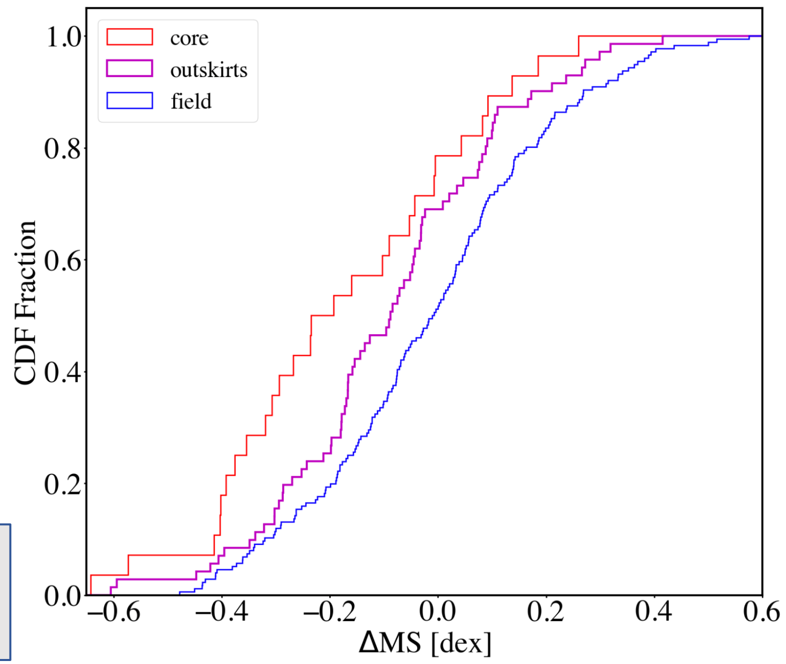


Red Sequence selected Cluster

(CAMIRA)
(Oguri et al 2018)

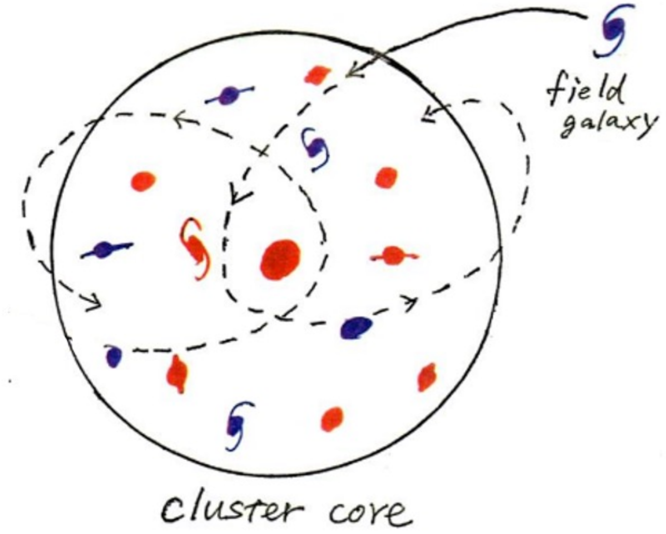


Laishram et al (in Prep)



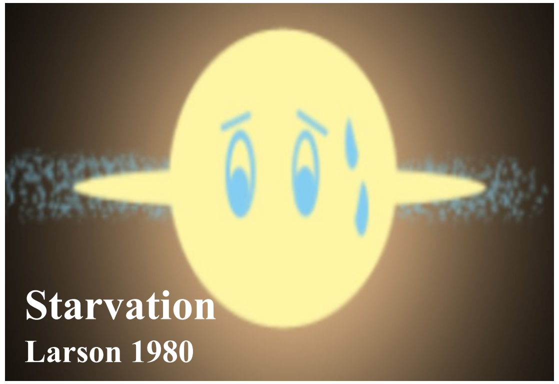
core: within 1 Mpc
outskirts: >1Mpc, <=4Mpc
field: >4Mpc, <10Mpc

Lower star forming activites inside the cluster core compared to outskirt and field.



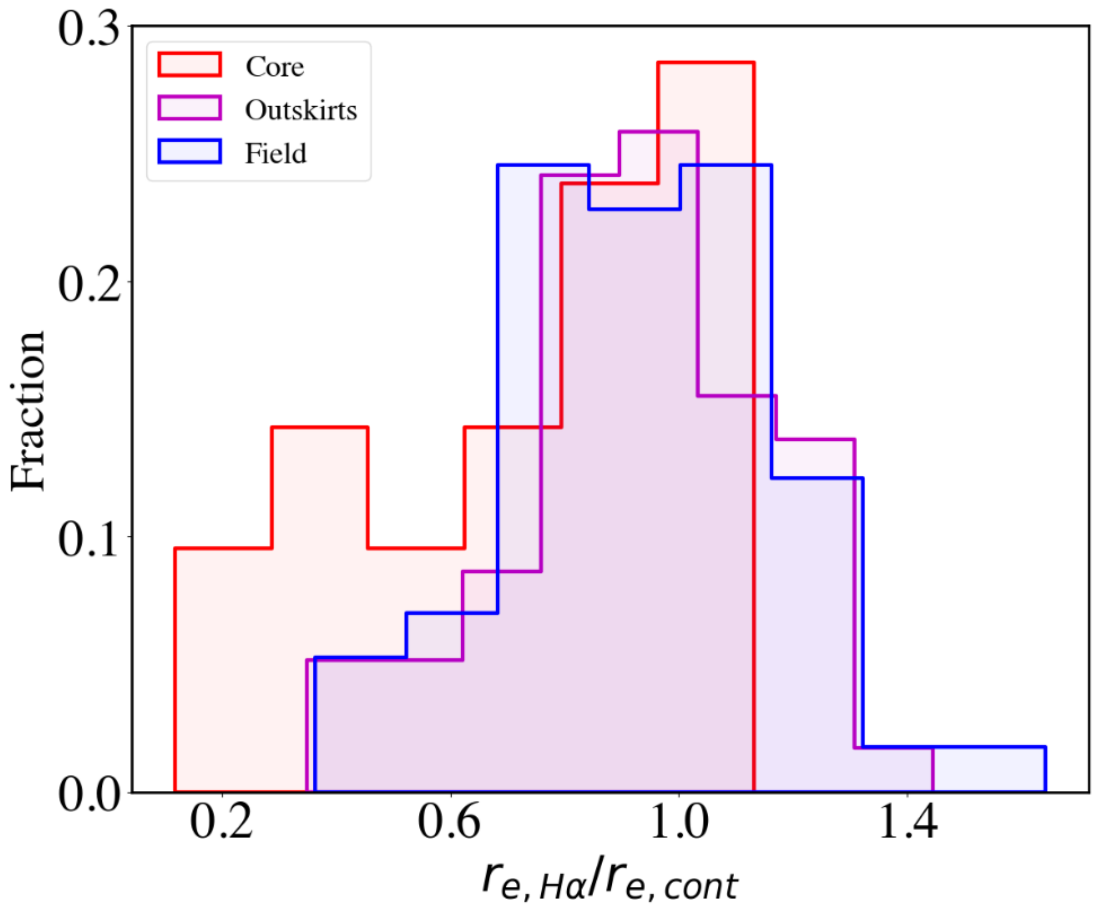
Illustrated bt Aeree Chung

Stars | ISM | ICM



- **At low redshift, Red Sequence cluster are older, more developed and there are cluster specific quenching processes such as ram pressure stripping, starvation etc which reduce the SF activity**

Emission line–continuum size ratios



Using NB921 and z band image
- ❑ Ha image
- ❑ Stellar continuum image

Effective radius obtained using GALFIT

Laishram et al (in Prep)

re, Hα / re, cont**: core < outskirts < field**

Evidence for truncated Hα discs in galaxy clusters core compared to the fields.

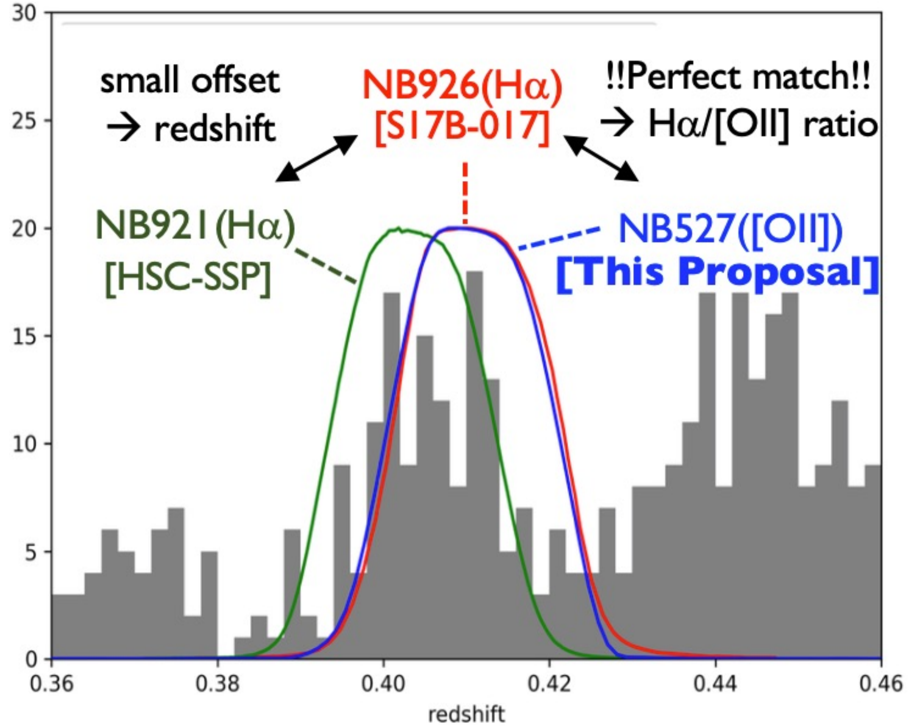
- ❖ **Ram-pressure stripping**

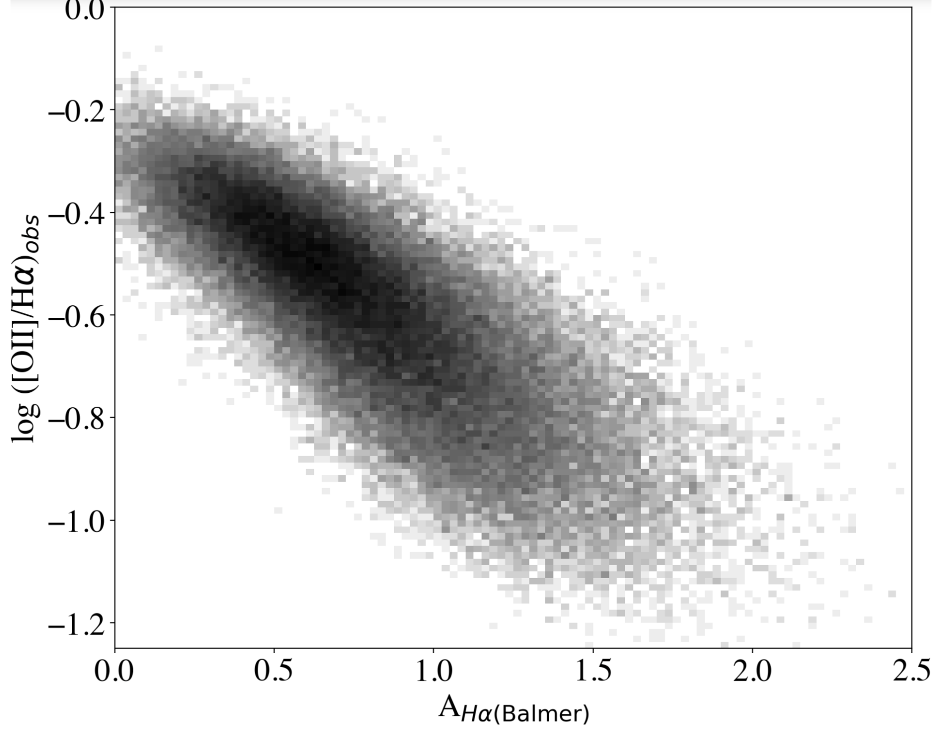
Dust Extinction

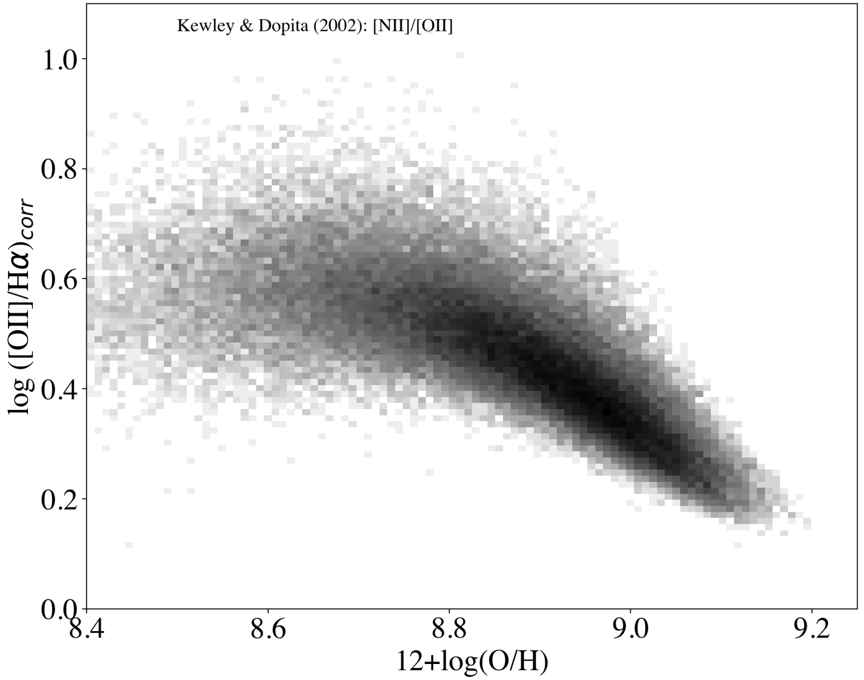
Preliminary results

SDSS Sample

Underlying relationship between [OII] and Ha emitters

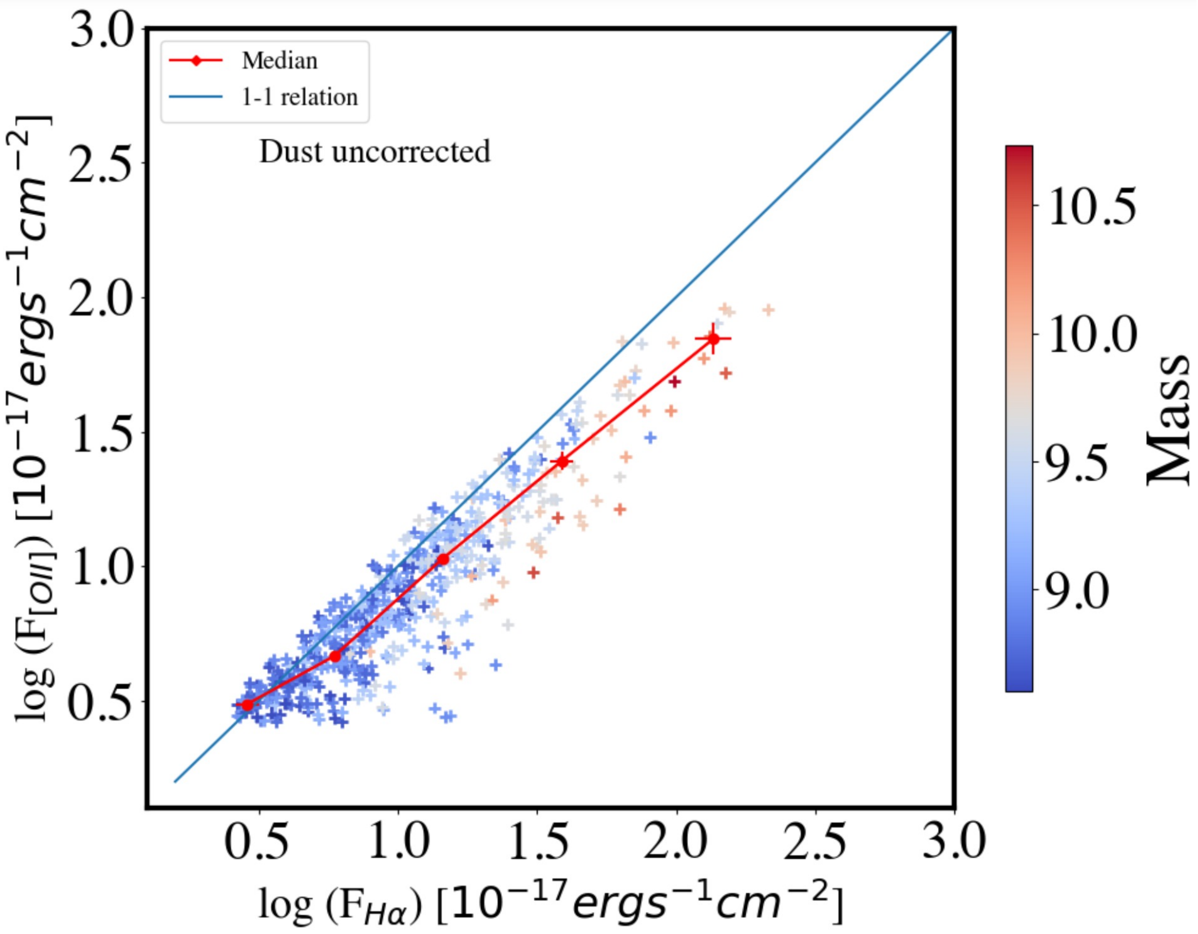


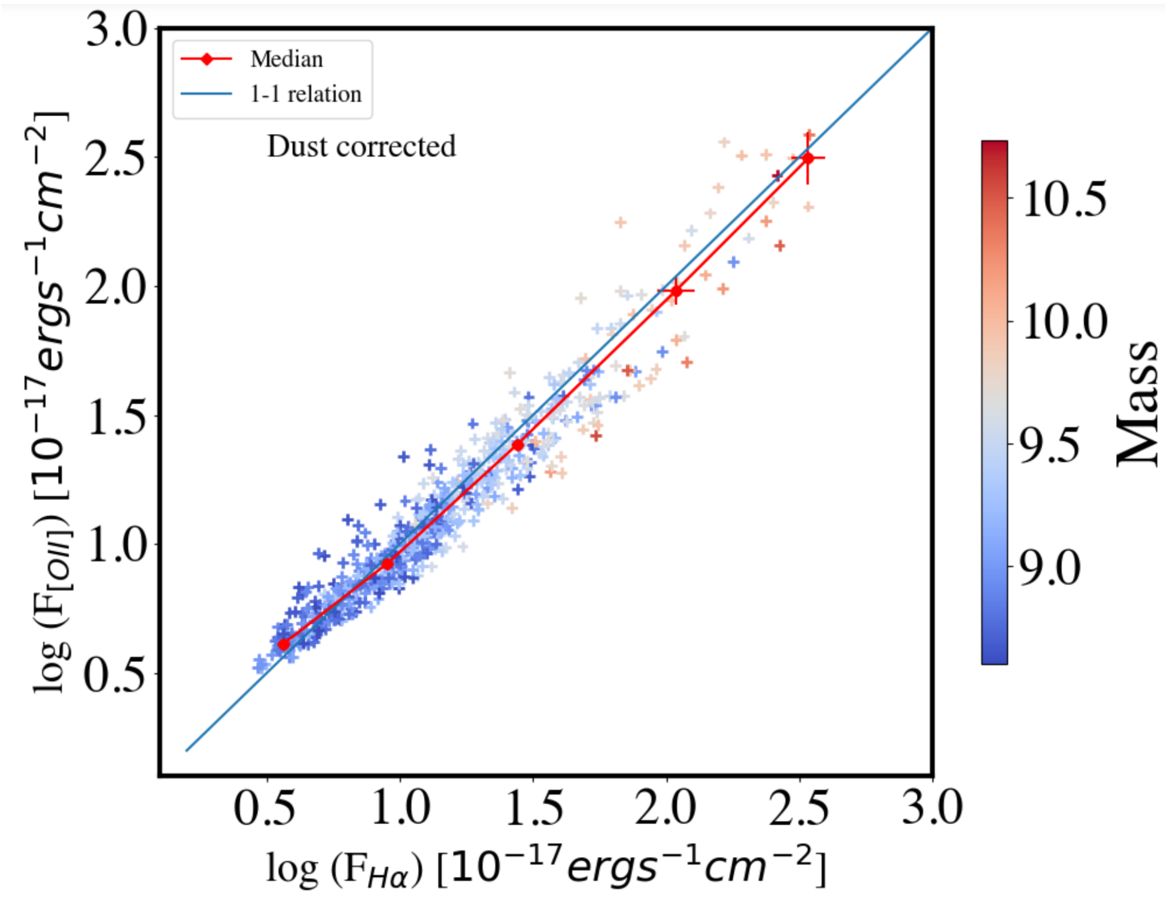




- [OII]/Hα line ratio is sensitive to dust extinction due to difference in rest-frame wavelength of the two emission lines.
  - metallicity can affect the line ratio as well.

$$[OII]/H\alpha = f\,(A_{h\alpha} + 12+\log(O/H)$$





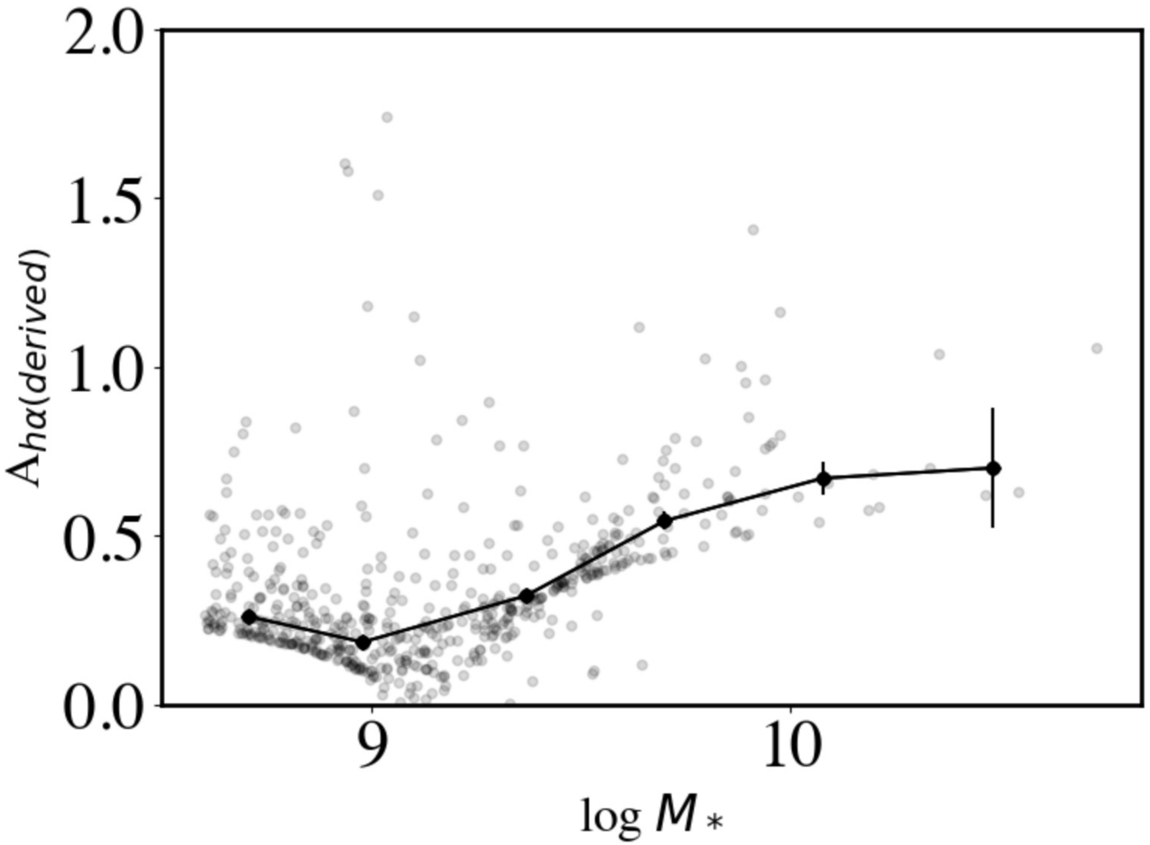
F([OII]λ3727) and F(Hα) are correlated

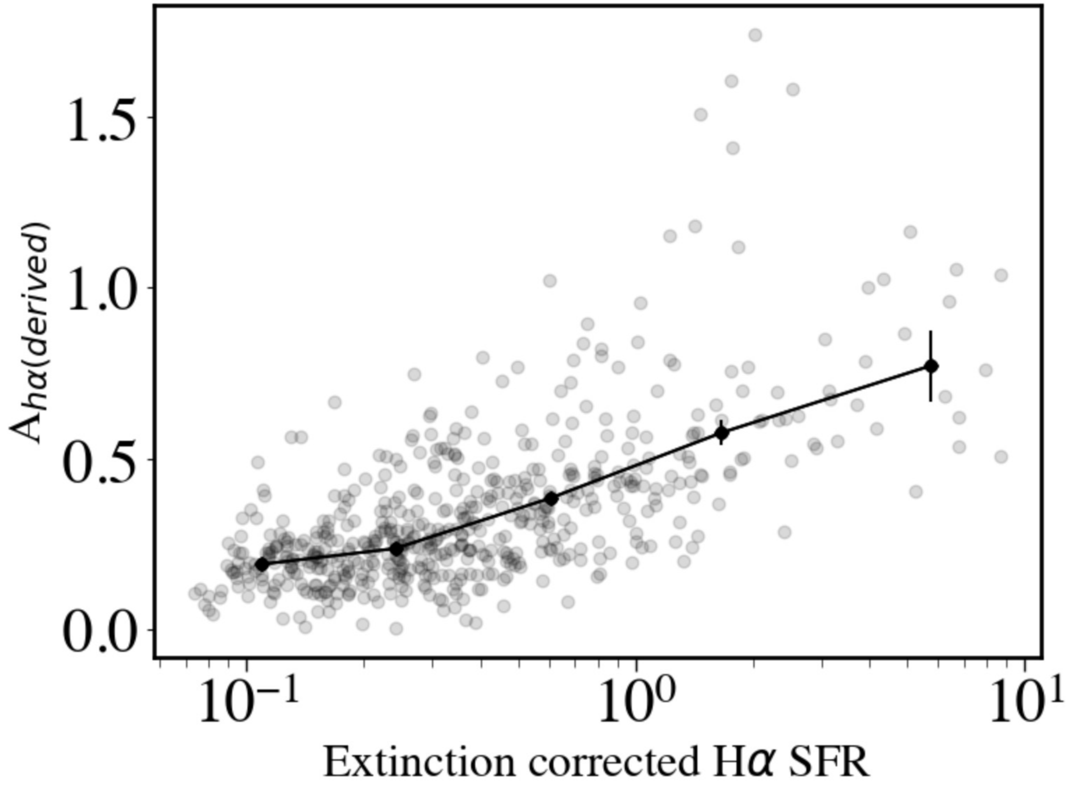
- With no extinction correction, the correlation between F([OII]λ3727) and F(Hα) has a very large dispersion.
- after these corrections, the intensities of these two emission lines are all significantly increased
  - correlation between F([OII]λ3727) and F(Hα) is enhanced
  - the dispersion of the correlation between F([OII]λ3727) and F(Hα) is remarkably reduced.

Preliminary results

1. Derived the empirical relationship of $A_{h\alpha}$ as a function of [OII]/Hα and metallicity (12+log(O/H) fitted by 4th order polynomial function
2. At z~0.4: Using [OII]/Hα and metallicity (derived from mass-metallicity relation), $A_{h\alpha(derived)}$ is obtained

$[OII]/H\alpha = f(A_{h\alpha} + 12+\log(O/H)$

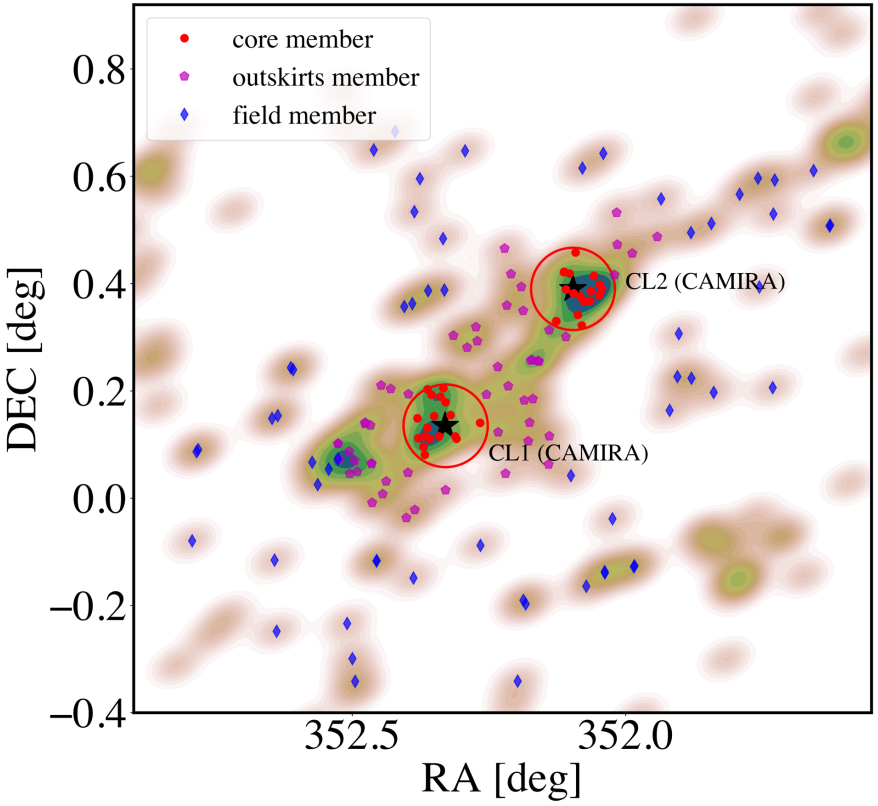


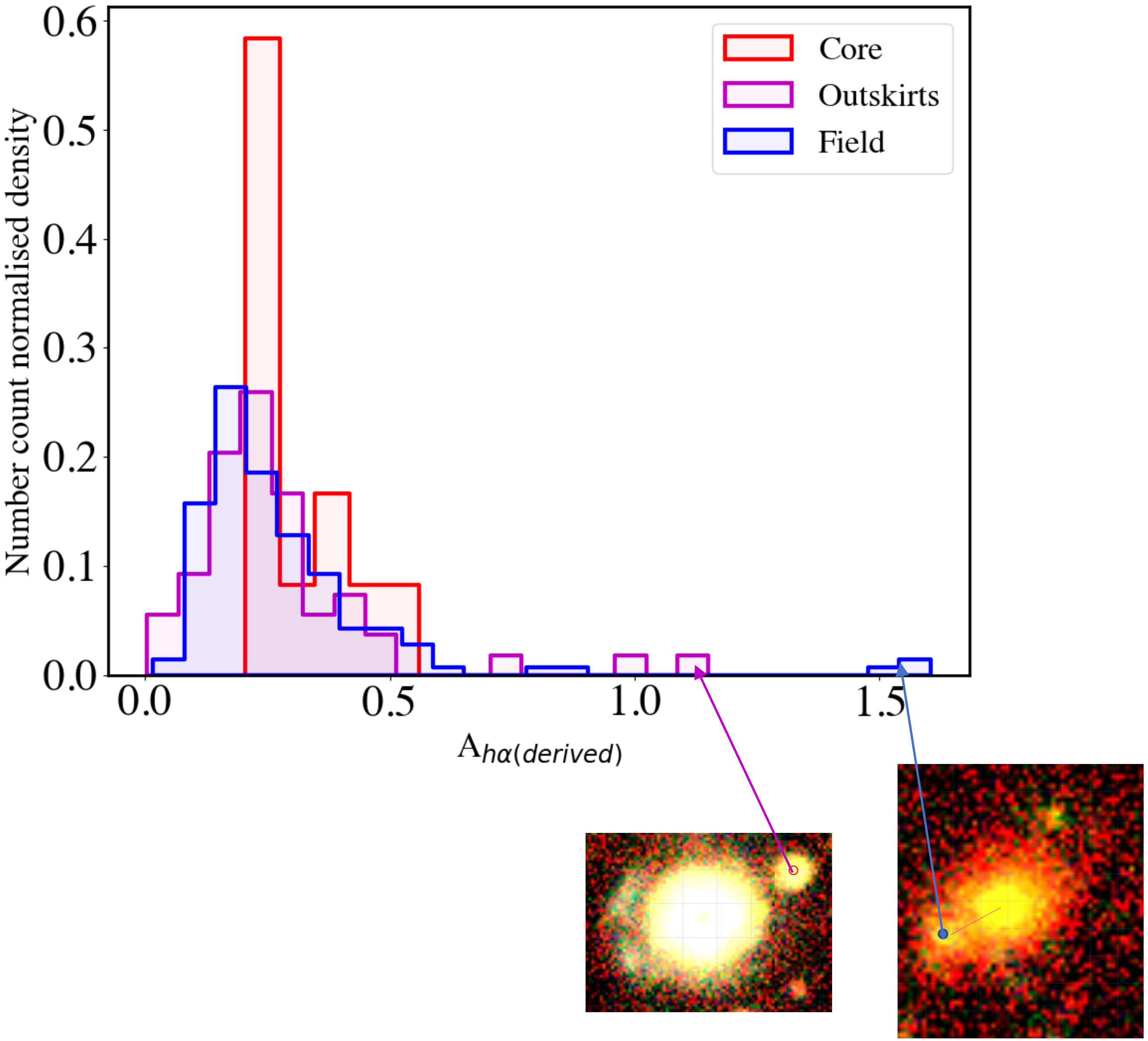


- Higher dust extinction with increasing stellar mass
  - ➢ massive galaxies may have built up a larger dust reservoir with which to attenuate Hα radiation

Preliminary results

Preliminary results





METHODS

- Novel method to estimate accurate redshifts and emission line fluxes of SF galaxies
- 3D Mapping and Structure separation at thin redshift slice and reduce the projection effect
- Investigate the projected corrected environmental dependence of galaxy properties with local density.
- Hα and stellar continuum image from narrow-band (NB921) and broad band (z) image
- Derived the empirical relationship between [OII]/Hα = f ($A_{h\alpha}$ + 12+log(O/H) from SDSS data

RESULTS & INTERPRETATION

- At low redshift, Red Sequence cluster are older, more developed and there are cluster specific quenching processes such as ram pressure stripping etc which reduce the SF activity
- Evidence for truncated Hα discs in galaxy clusters core compared to the fields.
  - Ram-pressure stripping
- correlation between F([OII]λ3727) and F(Hα) is enhanced after dust correction

Thank You