IFU spectroscopy of high-z radio galaxies with SWIMS

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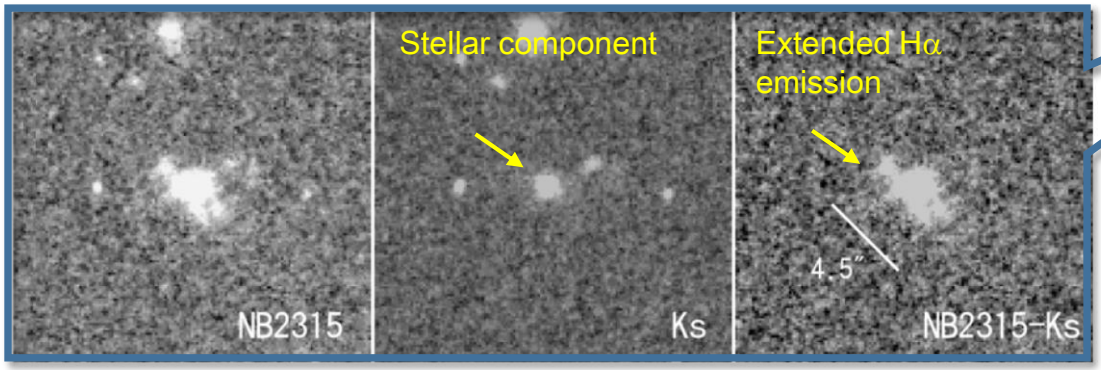
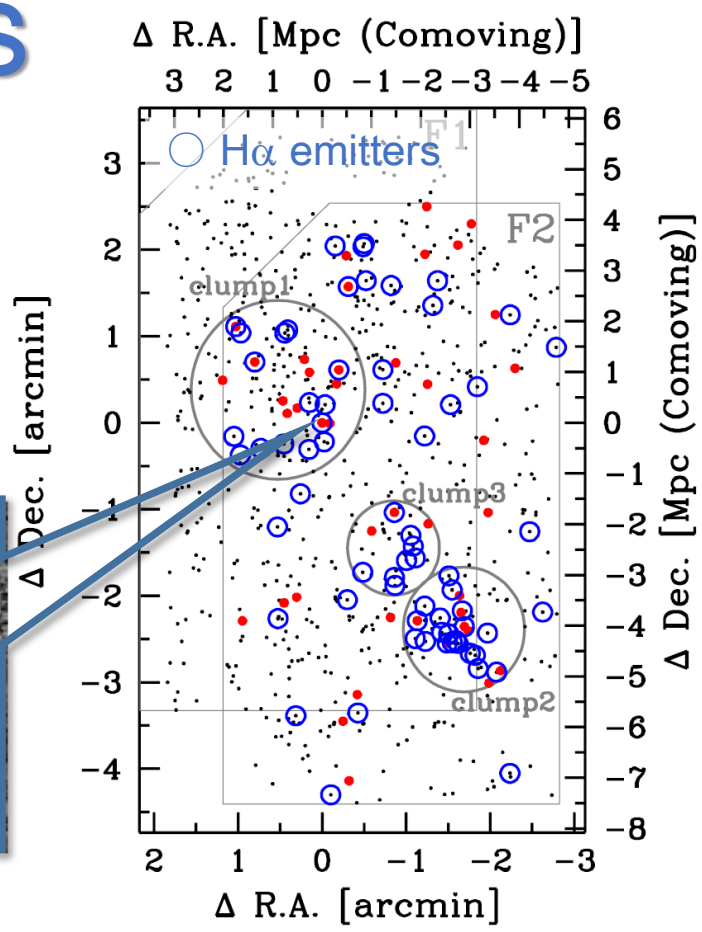
(NAOJ)



radio galaxy, USS1558-003, at z=2.53

Proto-cluster at z=2.53



Hayashi+2012

Mechanisms quenching star formation of galaxy

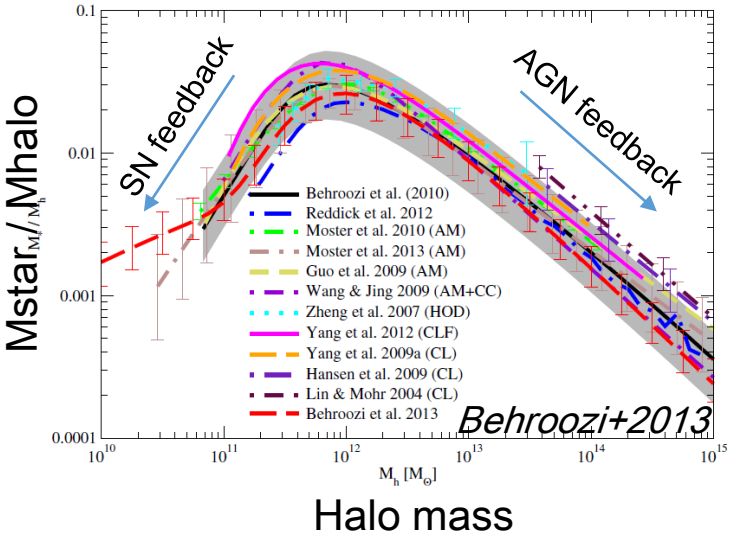
AGN feedback

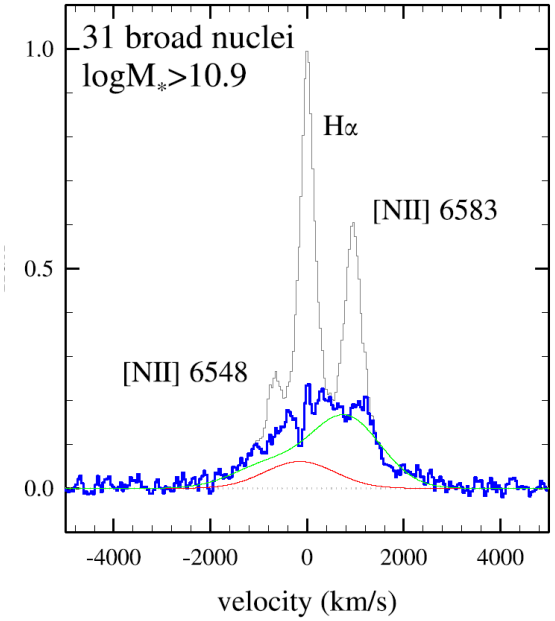
- Quasar (radiative) mode – radiative pressure and outflow of cold gas
- Radio (kinetic) mode – heating gas by radio jet

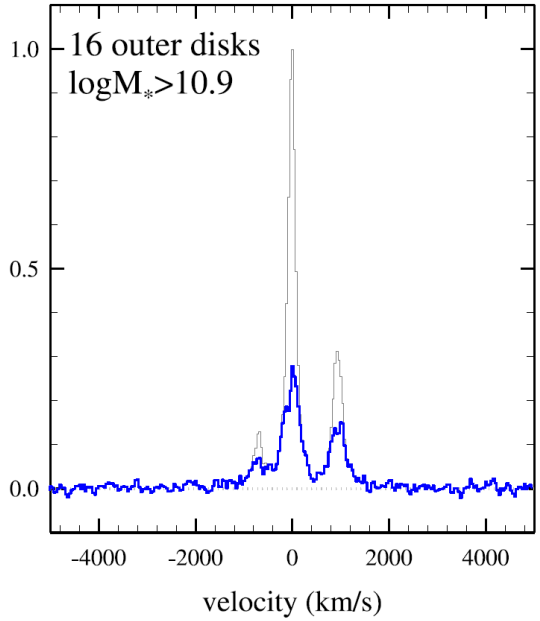
The most efficient star-formation in halo with ~10^{12} Msun

Broad component in the spectrum, which is indicative of outflow by AGN, is common feature for massive galaxies at z=1-3

Genzel+2014





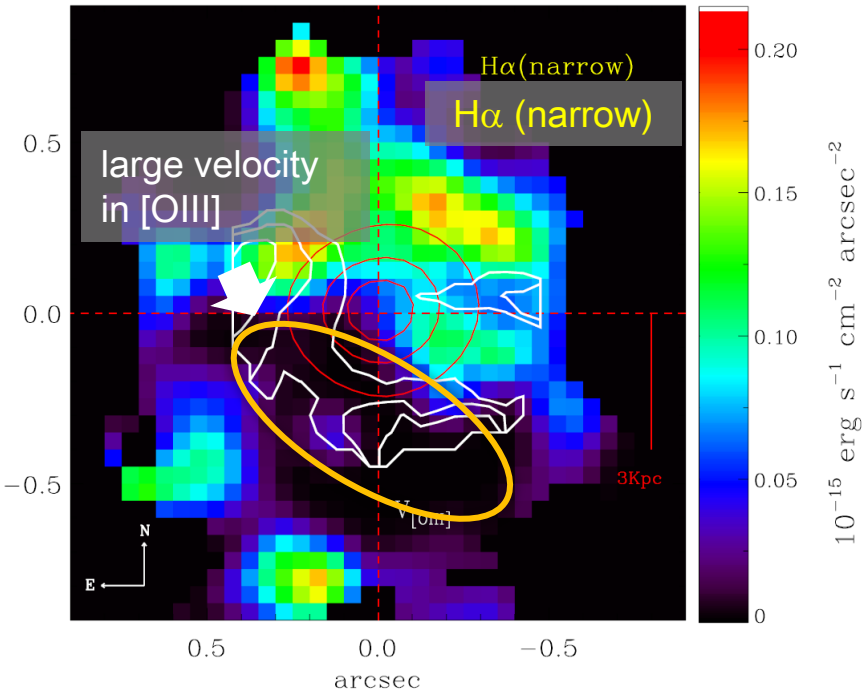


AGN feedback seems to have influence on regulating galaxy evolution

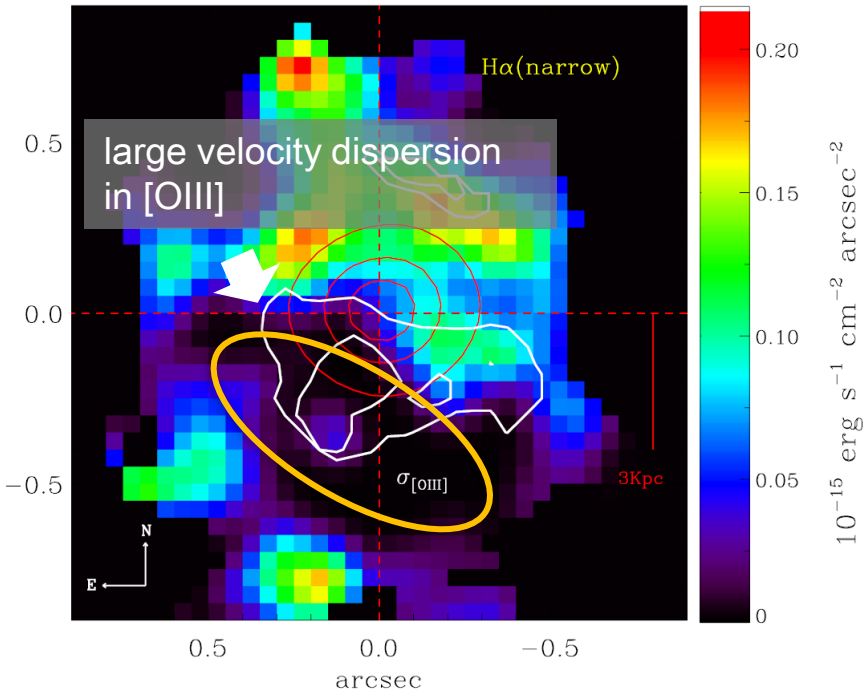
Direct evidence of AGN feedback (quasar mode)?

Quasar, 2QZJ0022830.4-281706 at z=2.4
VLT-SINFONI integral field spectroscopy

Cano-Diaz+2012



Contours of [OIII] velocity at 330, 360, and 390 km/s



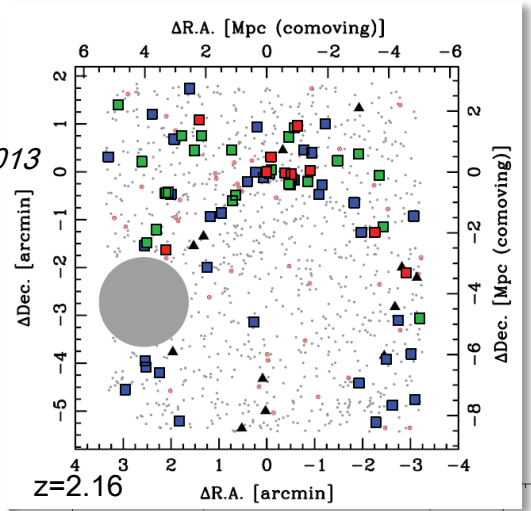
Contours of [OIII] velocity dispersion at 680 and 700 km/s

Suppression of Hα emission (i.e., star formation) by strong outflow

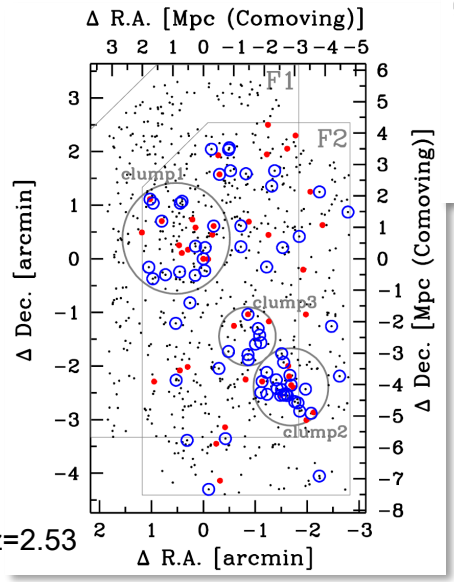
High-z radio galaxies as a landmark of proto-clusters

- High-z radio galaxies (HzRGs) are one of the most massive galaxies at high-z
- They are considered to evolve to the present-day massive galaxies
  (Most of them can be a progenitor of local massive early-type galaxies)
- Thus, HzRGs are frequently used as a landmark to find proto-clusters
  (e.g., Venemans+07, Kodama+07, Hatch+11)
- Many of HzRGs tend to have an extended emission (e.g., Villar-Martin+07)

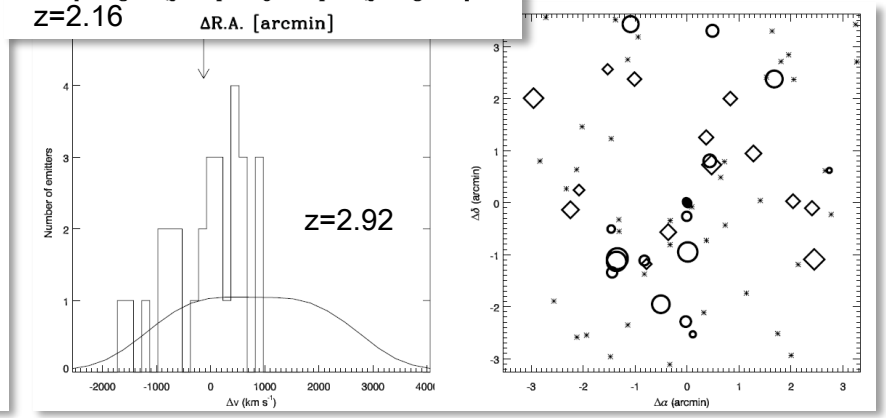
Koyama+2013



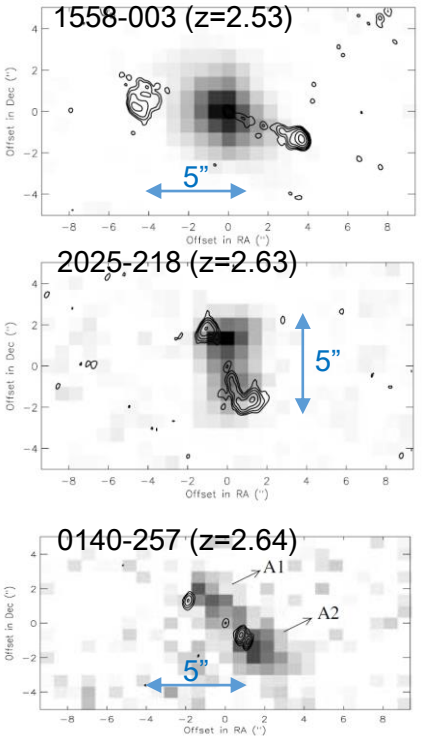
Hayashi+2012



Venemans+2007



Gray scale: Lyα
Contour: 8.2 GHz



Villar-Martin+2007

Spectroscopy of HzRGs with Integral Field Unit

Specification of SWIMS IFU

	TAO	Subaru
λ (μm)	0.9-1.45 (*blue*) & 1.45-2.5 (*red*)	
R (=λ/Δλ)	900-1400 (*blue*), 700-1200 (*red*)	
FoV	18.4" × 13.7"	14.0" × 5.2"
# of slice	26	13
Slice width	0.5"	0.4"

from SWIMS wiki

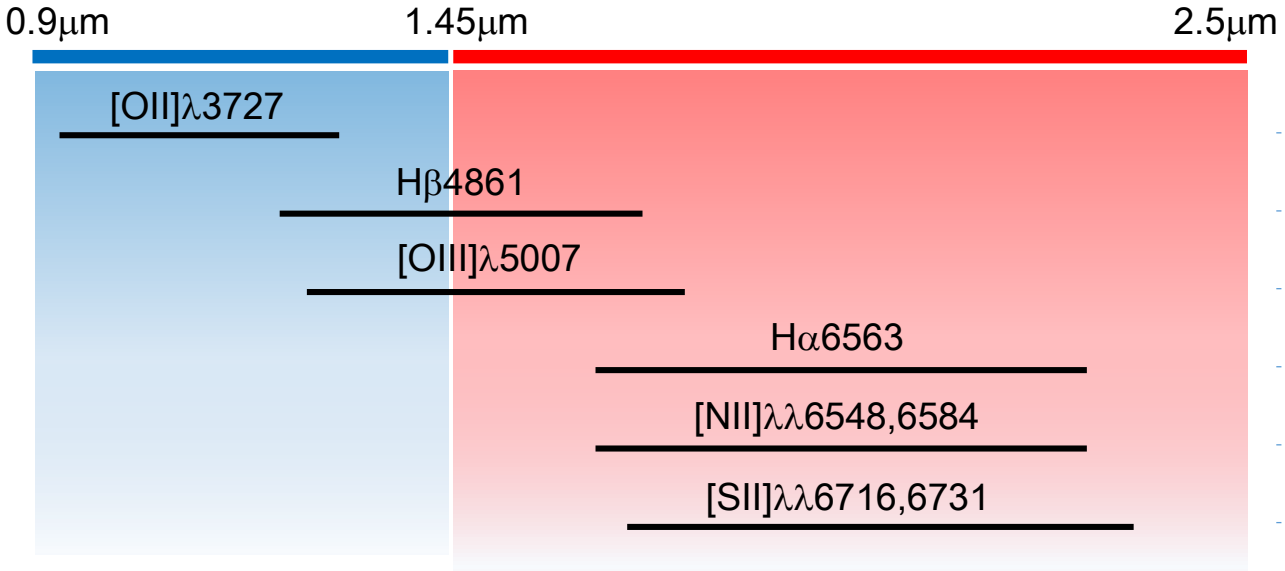
To spatially resolve HzRGs and than investigate the mechanism of the extended emission

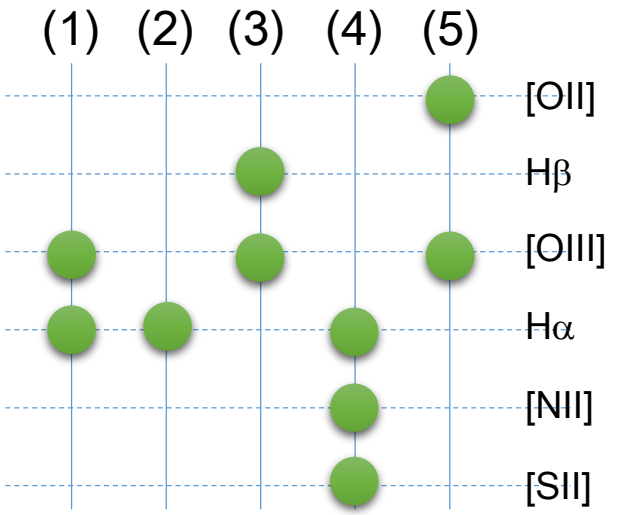
1"~8kpc @z=1.5-2.5

What is revealed from emission lines

(1) Kinematics of interstellar gas
(2) Star formation rate
(3) Dust extinction
(4) Excitation mechanism
(5) Ionization state

For galaxies at z=1.5-2.5



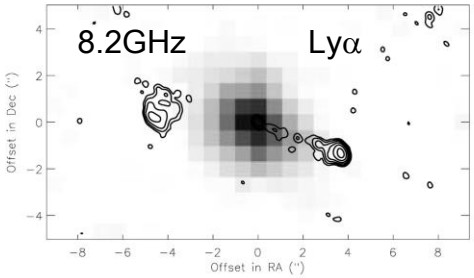


Examples of the targets

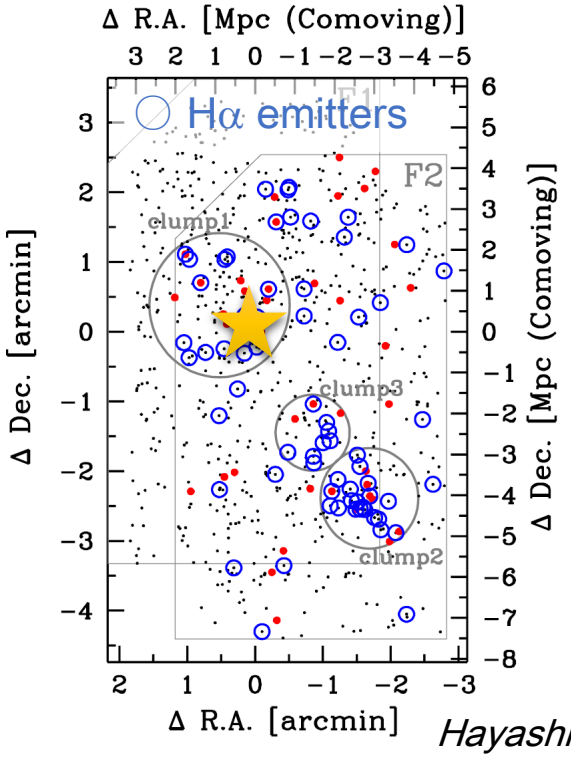
from MAHALO sample

- USS1558-003 radio galaxy at z=2.53
- In the central region of the proto-cluster
- Extended emission revealed by Subaru/MOIRCS NB imaging

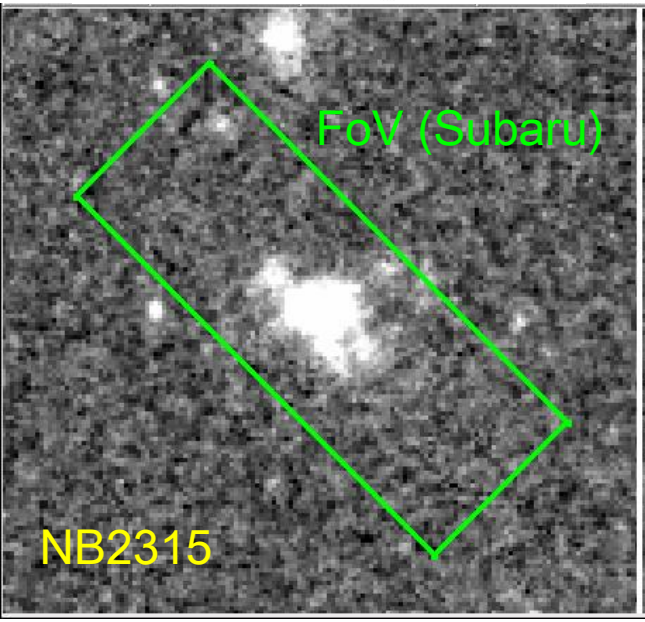
✓ A possible progenitor of BCGs

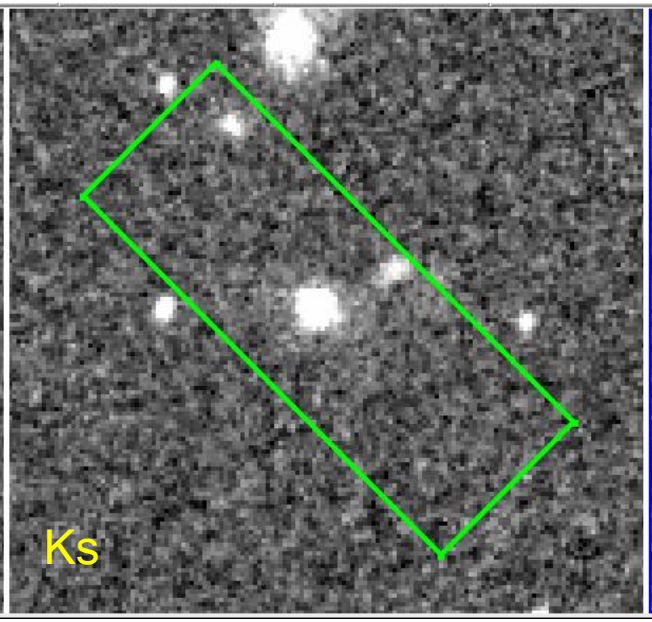


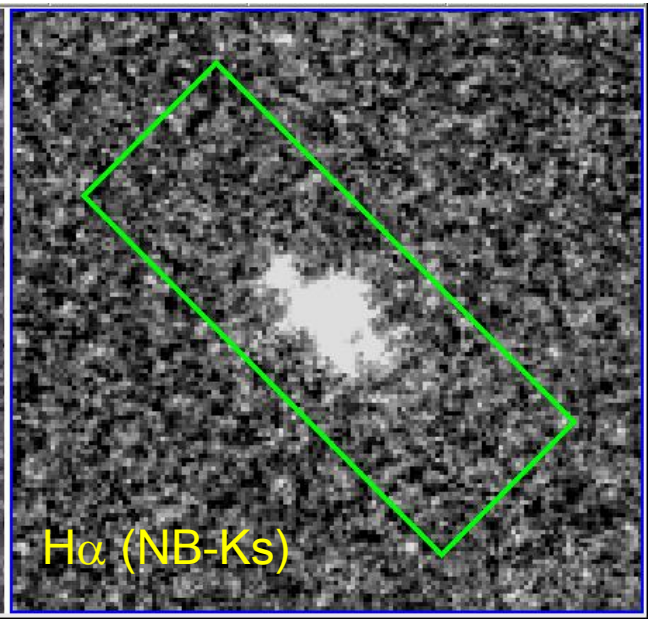
Villar-Martin+2007



Hayashi+2012





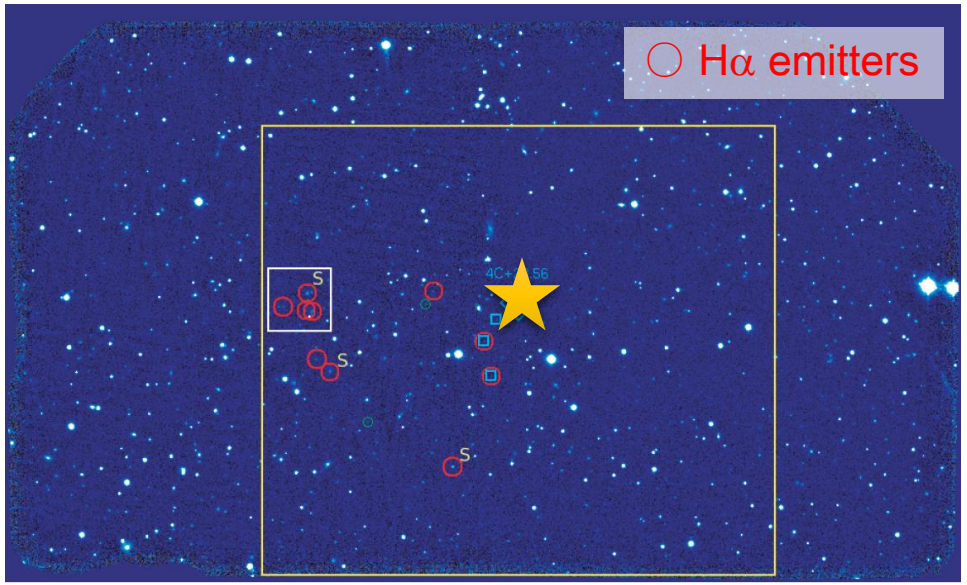


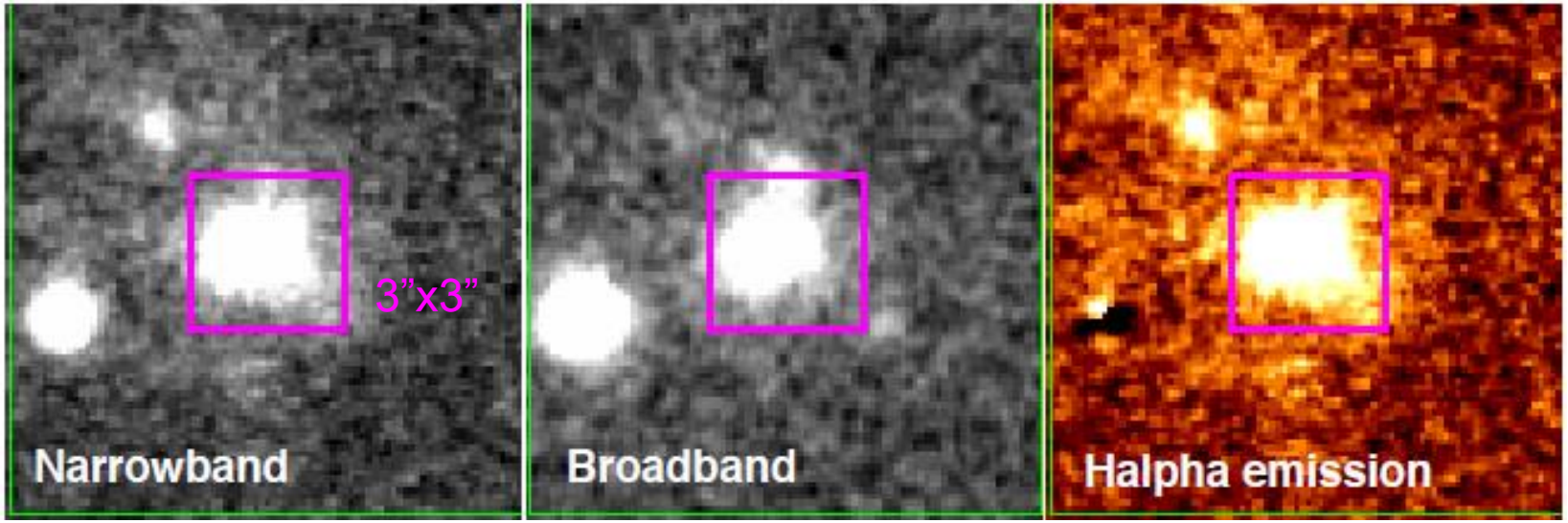
Examples of the targets

from MAHALO sample

- 4C+23.56 radio galaxy at z=2.48
- In the proto-cluster
- Extended emission revealed by Subaru/MOIRCS NB imaging

Tanaka+2011





Feedback from SN and/or AGN

(1) Kinematics of interstellar gas
(2) Star formation rate
(3) Dust extinction
(4) Excitation mechanism
(5) Ionization state

- Spatial distribution of [OIII] emission

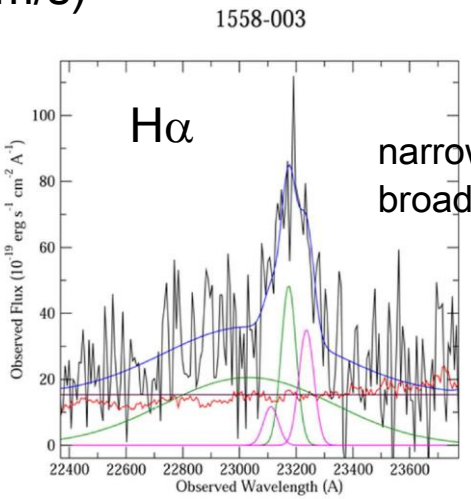
  Extended [OIII] emission → indicative of outflow

- Velocity of Hα emission (R=1000 → Δv~300km/s)

  Distinguishing SF from outflow

- Luminosity of Hα corrected for dust extinction with Hα/Hβ

  Location of star-formation →
  quenched (negative feedback)
  or stimulated (positive feedback)

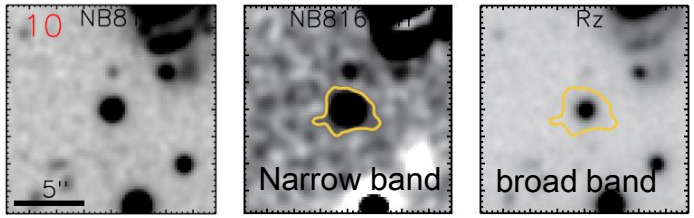


narrow component (SF)
broad component (outflow)

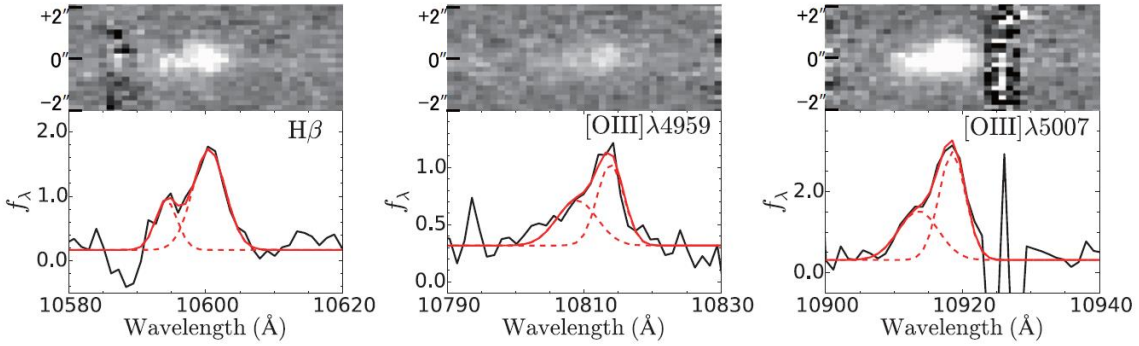
Humphrey+2008

[OII]3727 blob at z=1.18

Yuma+2013



Gas outflow with ~80-260 km/s



Spectroscopy with MOSFIRE

Harikane+2014

Excitation mechanism of gas

(1) Kinematics of interstellar gas
(2) Star formation rate
(3) Dust extinction
(4) Excitation mechanism
(5) Ionization state

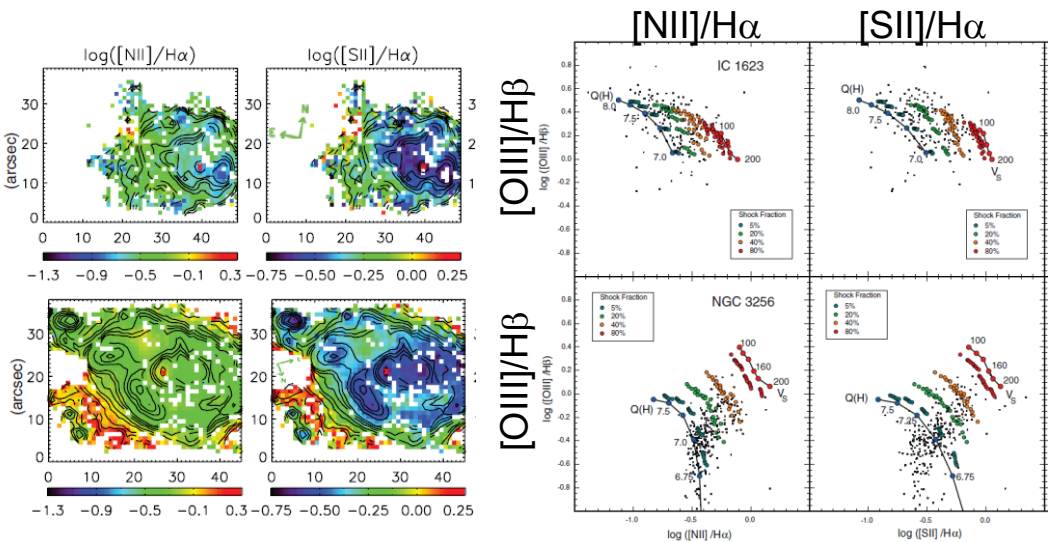
- Strong [NII] and/or [SII] emission

  → indicative of excitation by AGN or shock

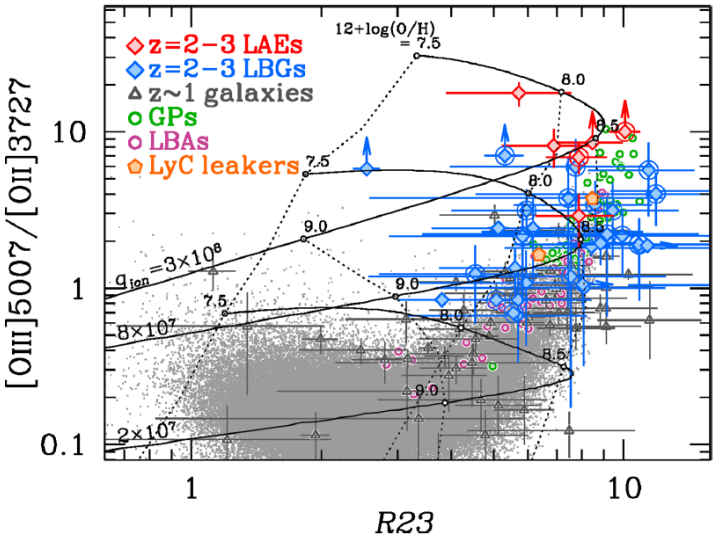
- Intensity ratio of [OIII] to [OII]

  → indicative of ionization state

Two nearby LIRGs *Rich+2011*



LAEs and LBGs at z=2-3 *Nakajima+2014*



Summary

- We propose to carry out the IFU spectroscopy of HzRG at z>2.
- Many of the HzRGs at z>2 are likely to evolve to BCG .
- HzRGs tend to have extended emission, which suggests feedback from AGN and/or SN.
- Resolving the extended emission spatially allows us to investigate the mechanism of the emission, gas outflow from galaxy, and (negative/positive) feedback from AGN/SN.
- Thus, such observations provide us with hints on how the massive galaxies at z>2 in proto-cluster evolve to the present-day BCGs.