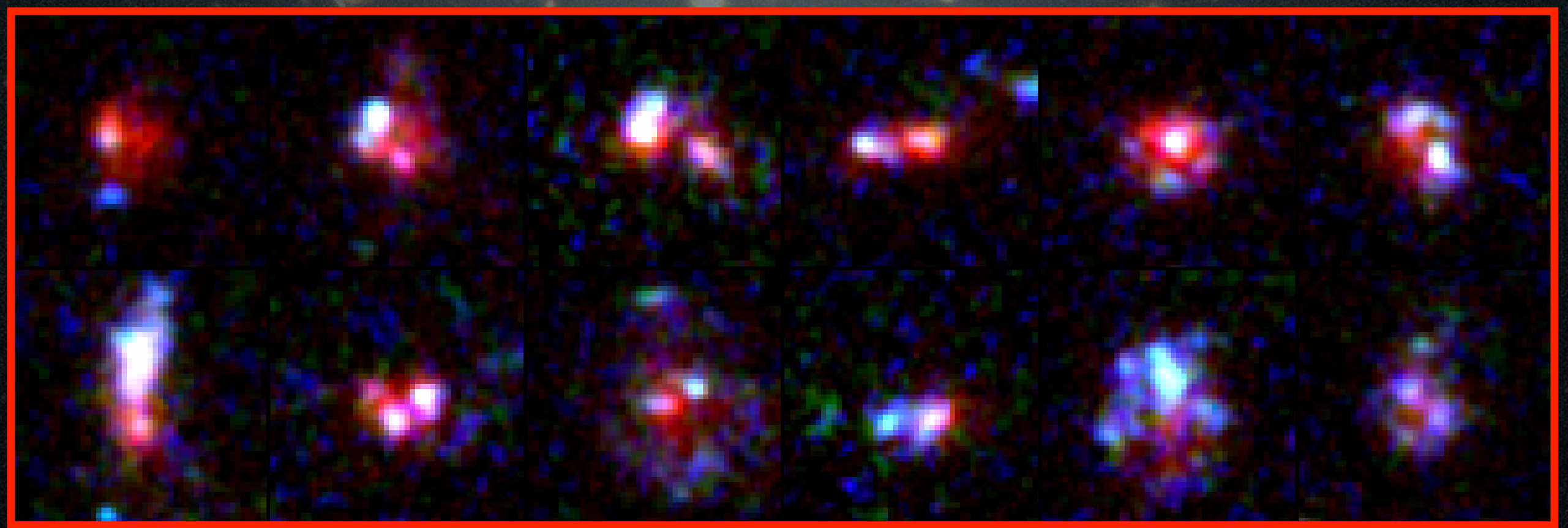
"Growing-up at high redshift: from proto-clusters to galaxy clusters"
ESAC, Madrid, 11 September, 2012

MAHALO-Subaru project :

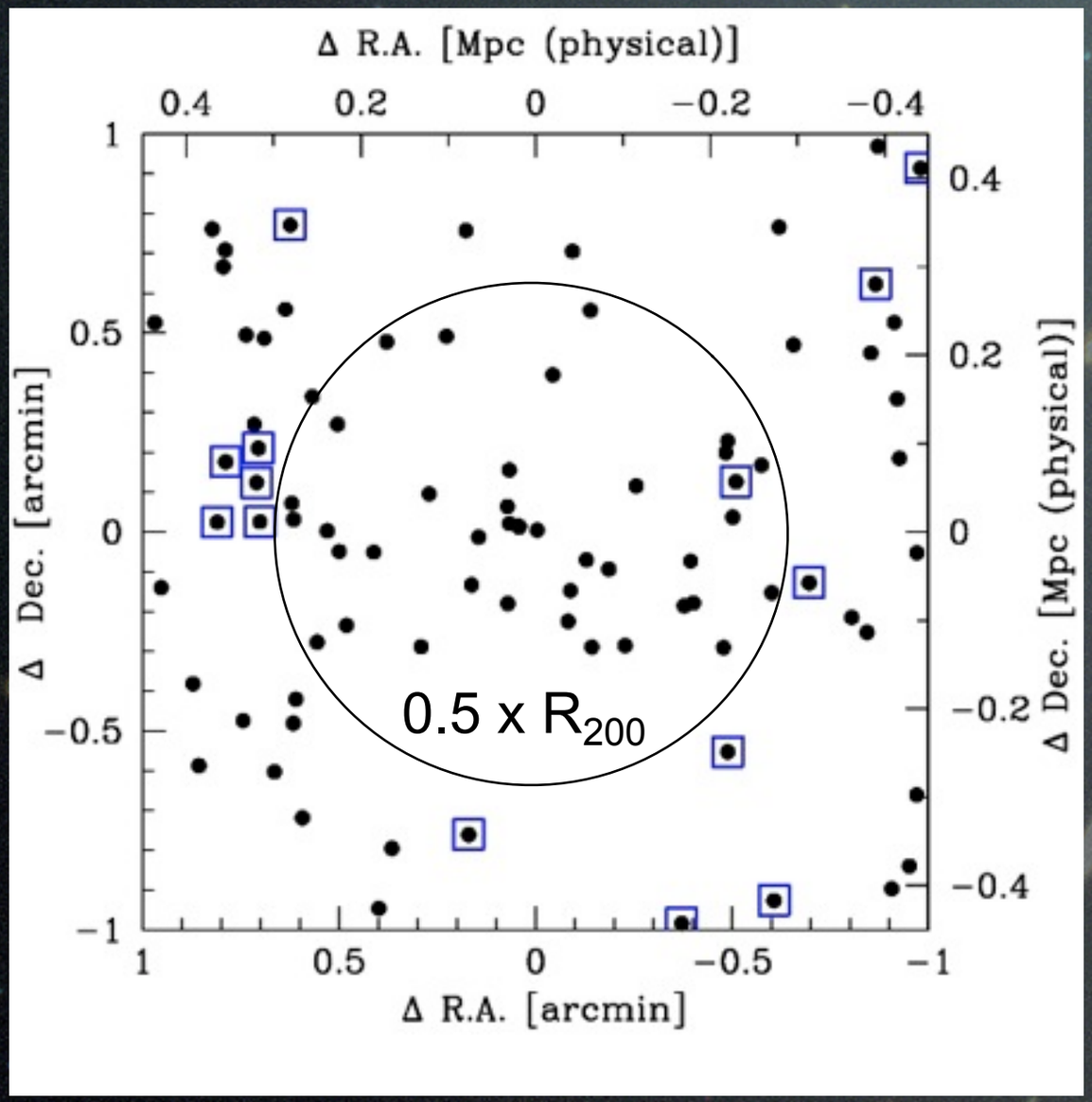
The accelerated growth of massive, star-bursting galaxies at z>2



Ken-ichi Tadaki
University of Tokyo

Spatial distribution of star-forming galaxies in clusters

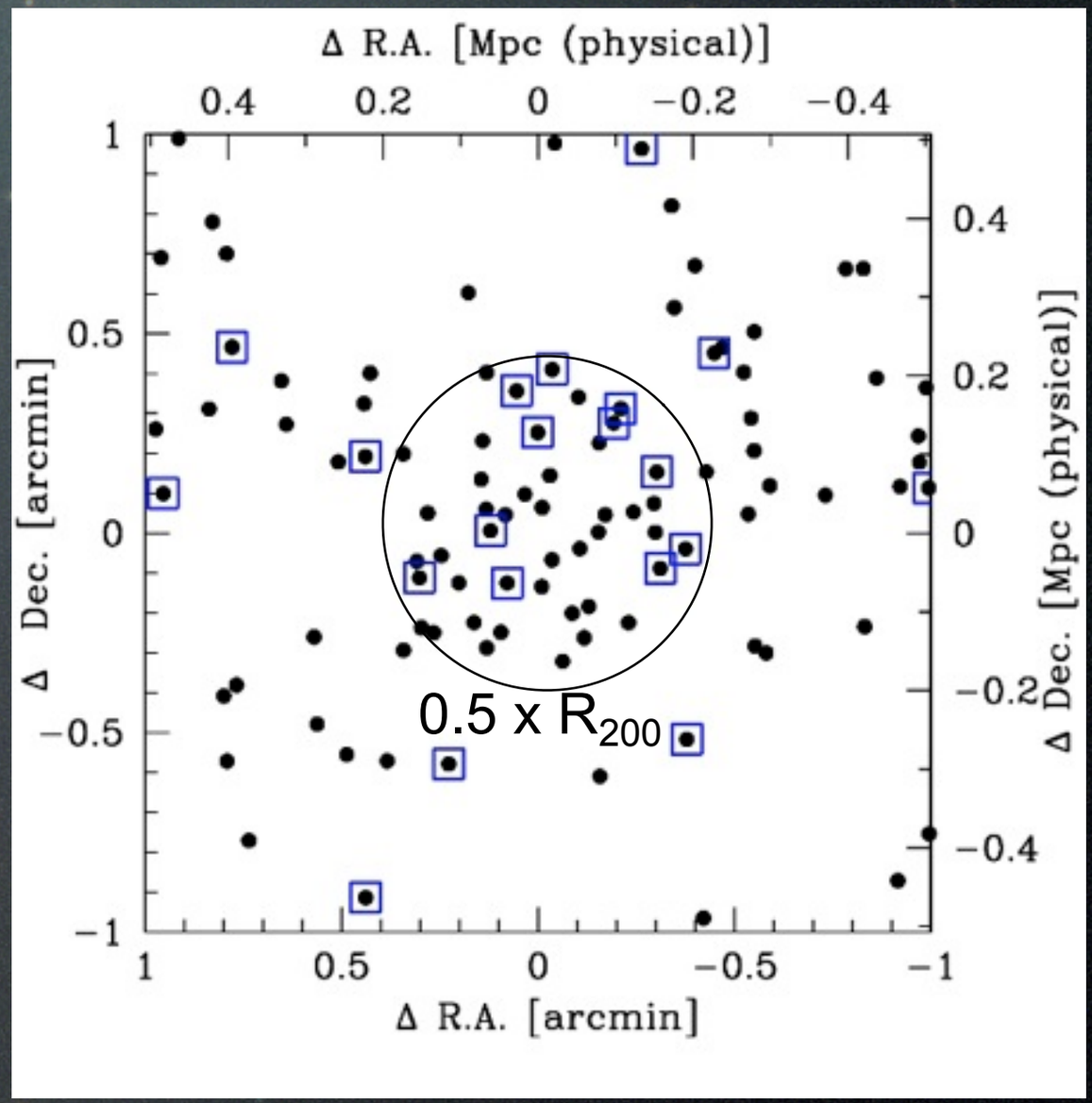
- Hα emittes at z=0.8 (RXJ1716)



Lx=2.7×10^{44} erg/s

Koyama, et al. (2011)

- [OII] emittes at z=1.5 (XCS2215)



Lx=4.4×10^{44} erg/s

Hayashi, et al. (2010)

Clusters Grow Inside-Out !

MAHALO Subaru project

MApping HAlpha and Lines of Oxygen with Subaru (PI: Taddy Kodama)

→ A narrow-band survey of star-forming galaxies at 1.5<z<2.5

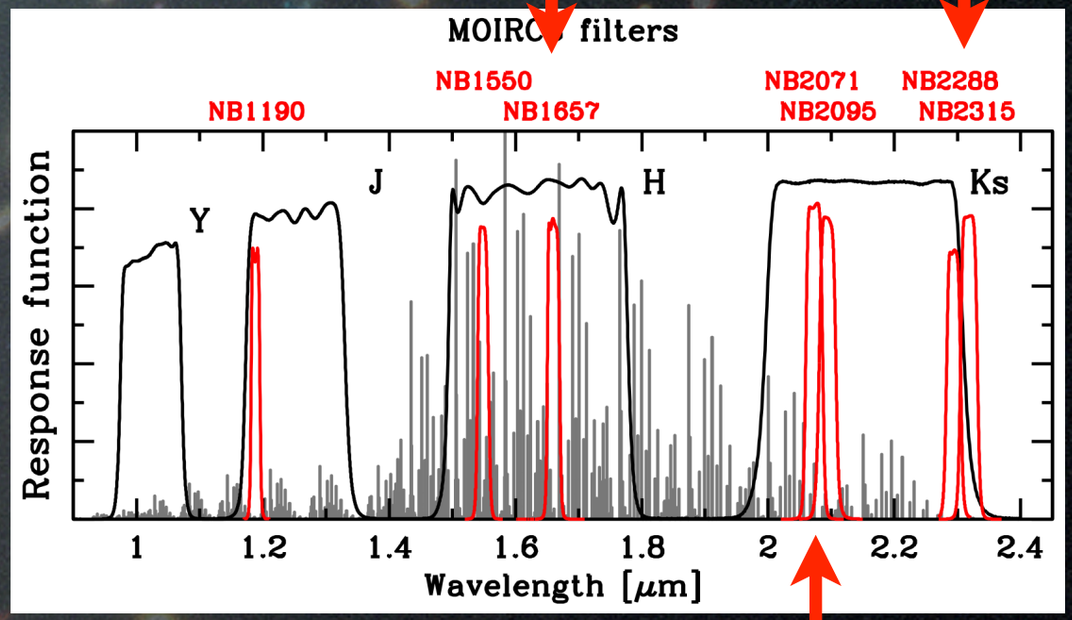
1. Cluster environment (extreme environment)

Target	Redshift	Reference
XCSJ2215	1.46	Hayashi+10,11
4C65.22	1.52	Koyama+
Q0835	1.53	Shimakawa+
CL0332	1.61	Hayashi+
CIG J0218	1.62	Tadaki+12
PKS1138	**2.16**	**Koyama+12**
4C23.56	2.48	Tanaka+11
USS1558	**2.53**	**Hayashi+12**

2. Field environment (unbiased sample)

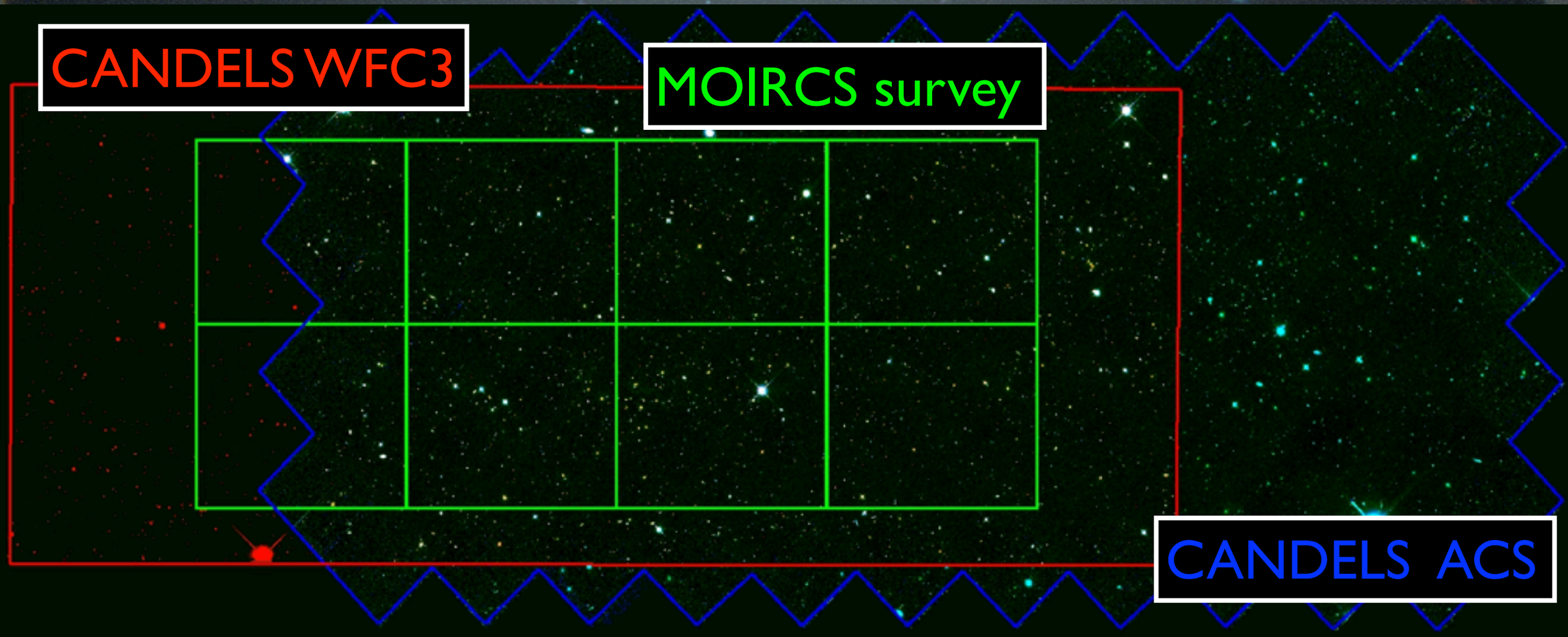
GOODS-N	2.19	Tadaki+11
SXDF-CANDELS	**2.19**	**Tadaki+**
SXDF-CANDELS	2.53	Tadaki+

z~1.5 z~2.5



Hα line at z~2.2

Hα emitter survey in CANDELS field



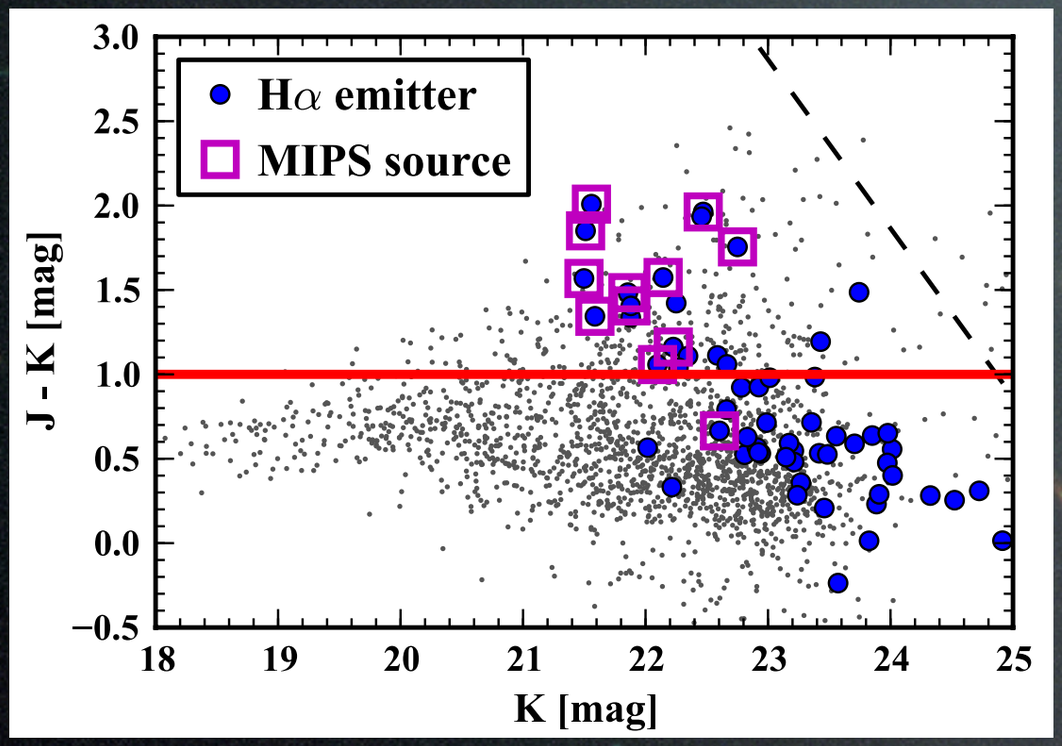
Field and area	SXDF-CANDELS ~90 arcmin^2
Instrument	Subaru/MOIRCS
Filter	NB209
z=2.2 emitter	**60**

Available infrared data in this field

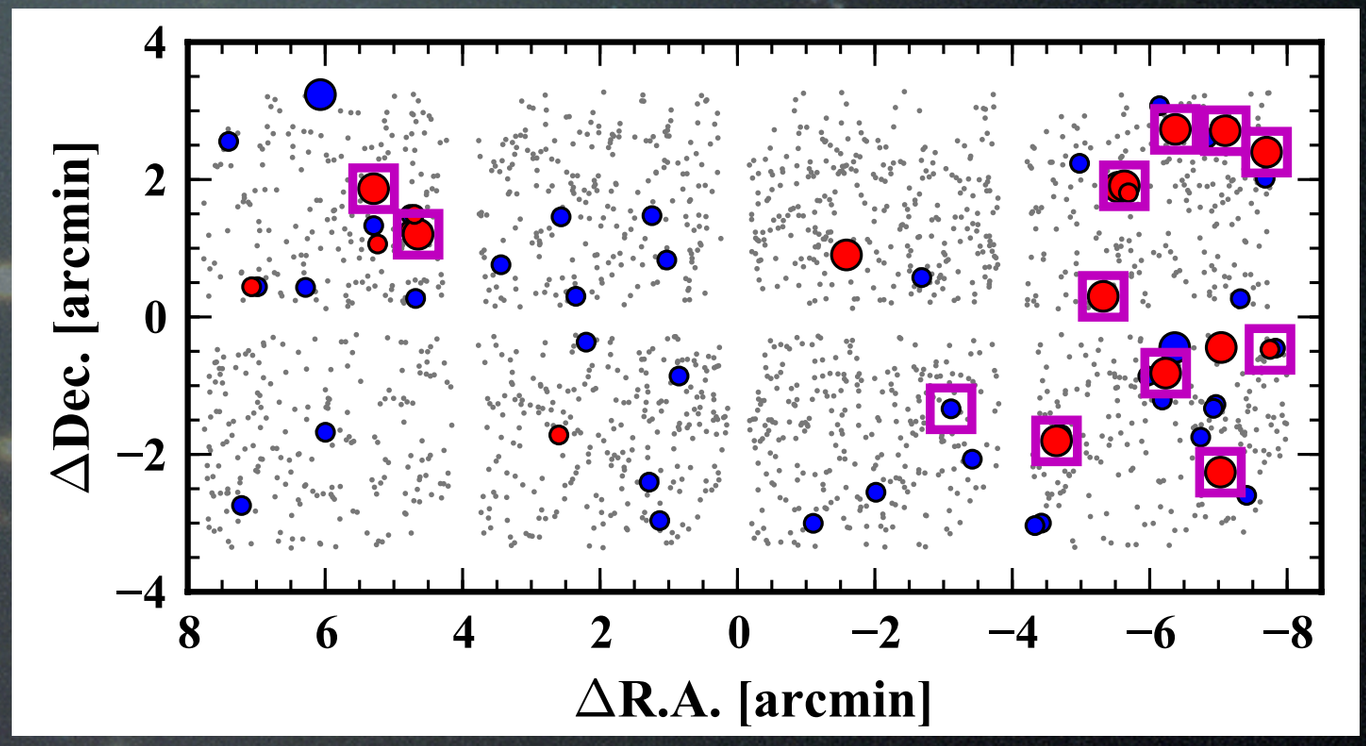
- Spitzer MIPS24um
- Herschel SPIRE, PACS
- ASTE/AzTEC 1.1mm

Global properties of Hα emitters at z=2.2

Color - magnitude diagram



2-D distribution



- red Hα emitters with J-K>1
- blue Hα emitters

Red emitters (J-K>1) are located in high density region
Most of red emitter are detected in MIPS 24μm

Question

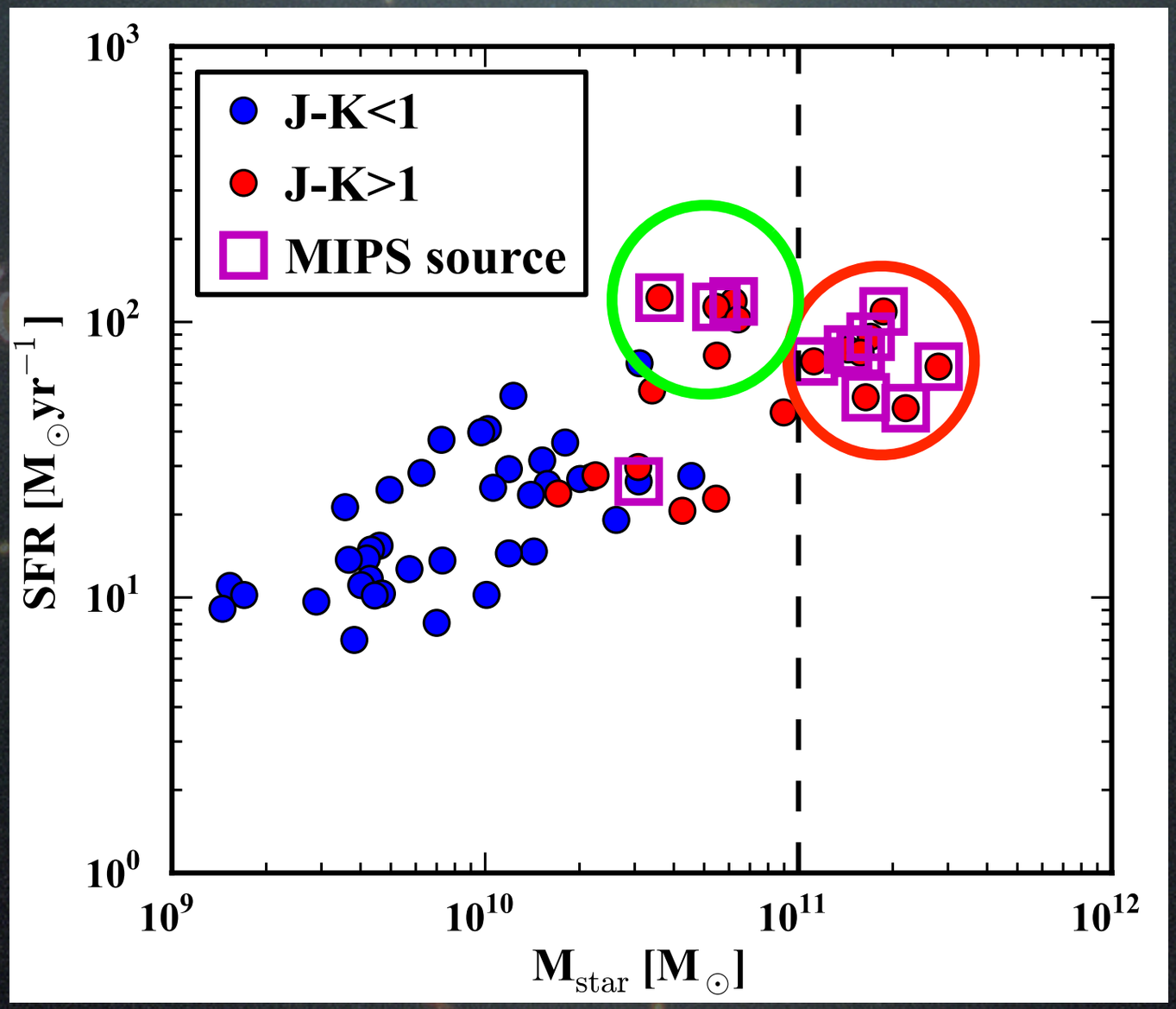
Why are red emitters “red” ?

1. red passive + blue star-forming
2. dusty starburst

The infrared emission are detected !

Global properties of Hα emitters at z=2.2

Stellar mass - SFR diagram

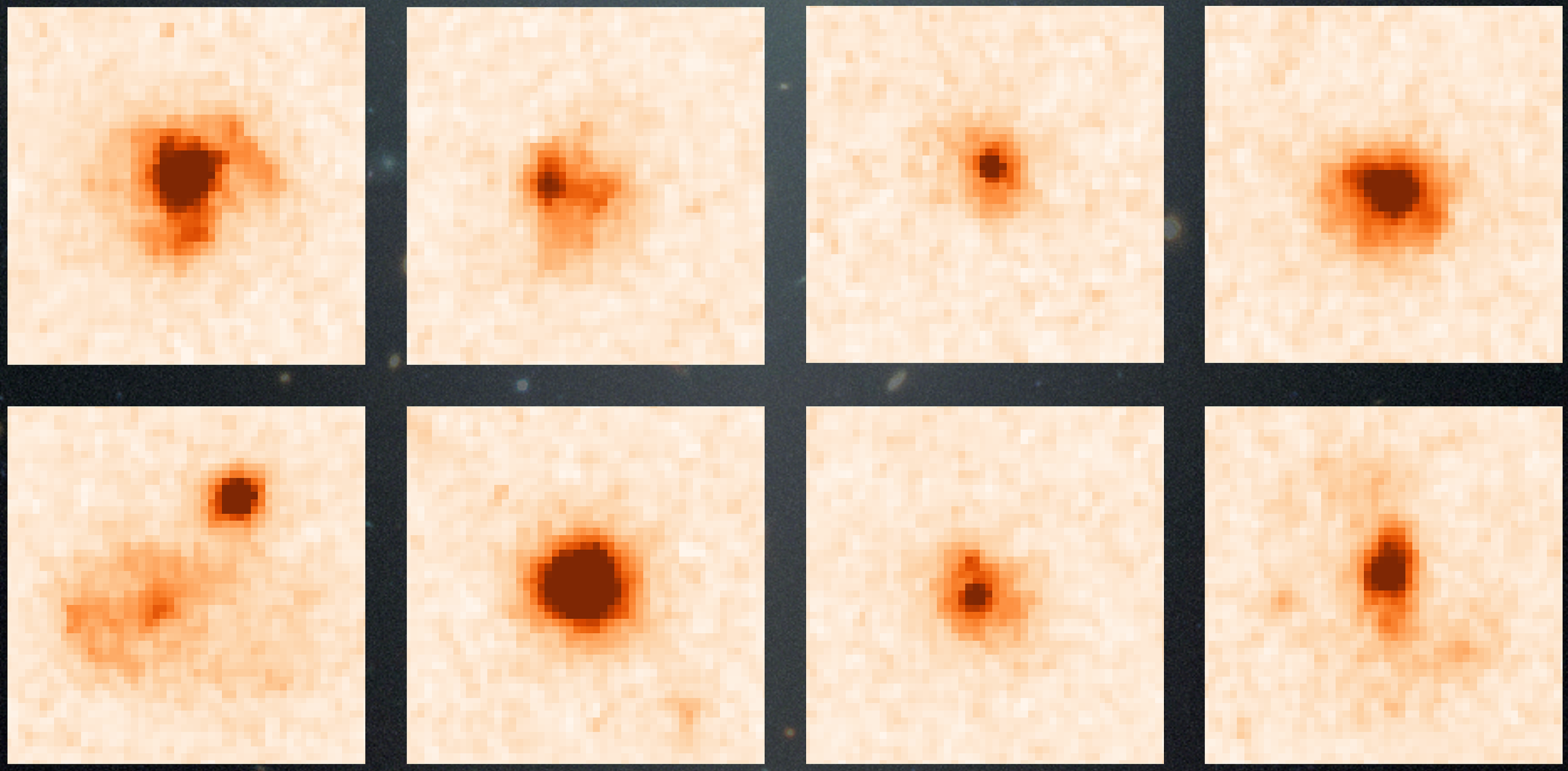


1. massive (M_{star}>$10^{11}M_\odot$), low specific SFR

2. less massive ($10^{10.5}M_\odot$<M_{star}<$10^{11}M_\odot$), high specific SFR

WFC3 H_{160} images

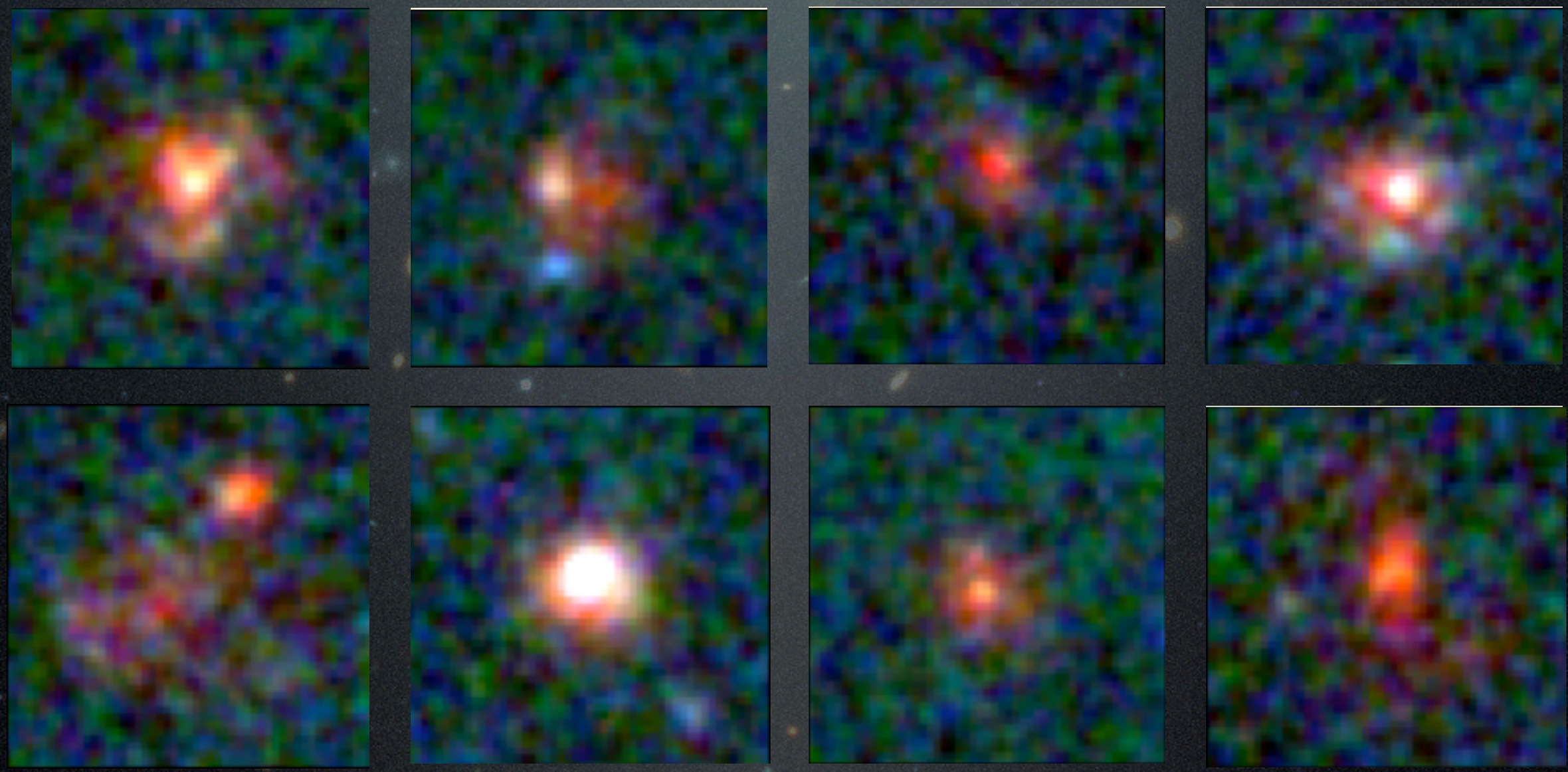
Red and MIPS-detected Hα emitters (M_{star}>$10^{11}M_{\odot}$)



irregular, but single core...

ACS V_{606}, i_{814} + WFC3 H_{160} images

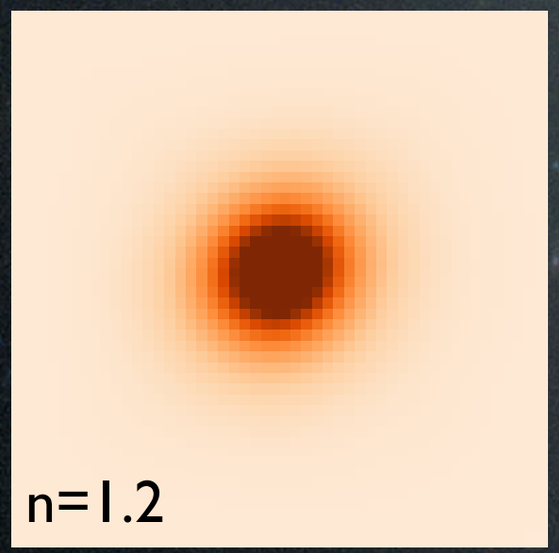
Red and MIPS-detected Hα emitters ($M_{star}>10^{11}M_{\odot}$)

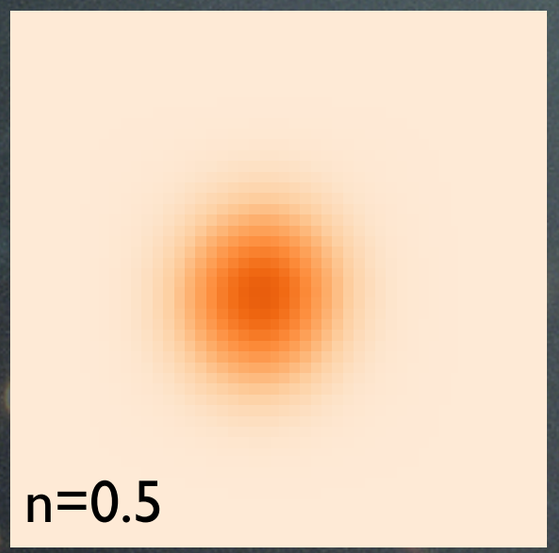


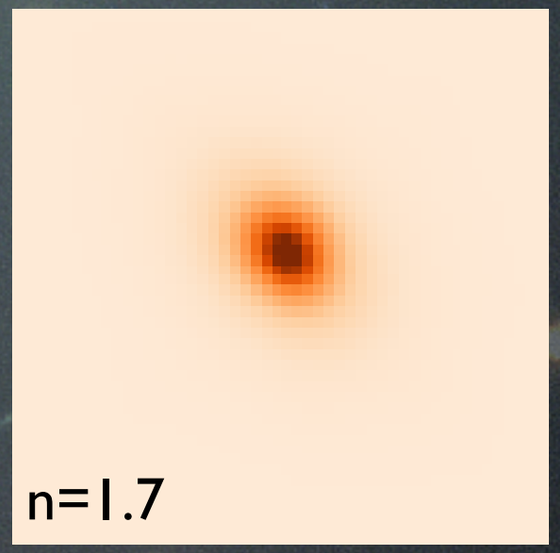
entirely red

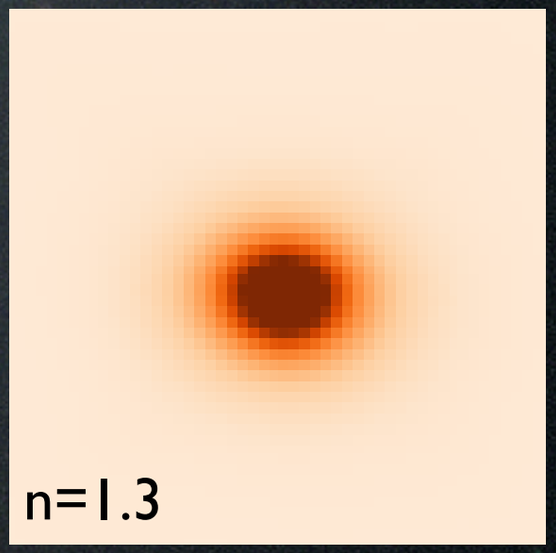
Single-component Models with GALFIT (Peng+10)

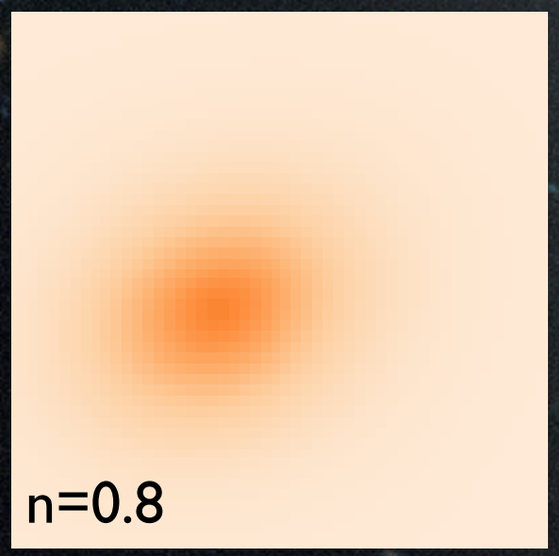
Red and MIPS-detected Hα emitters ($M_{star}>10^{11}M_{\odot}$)

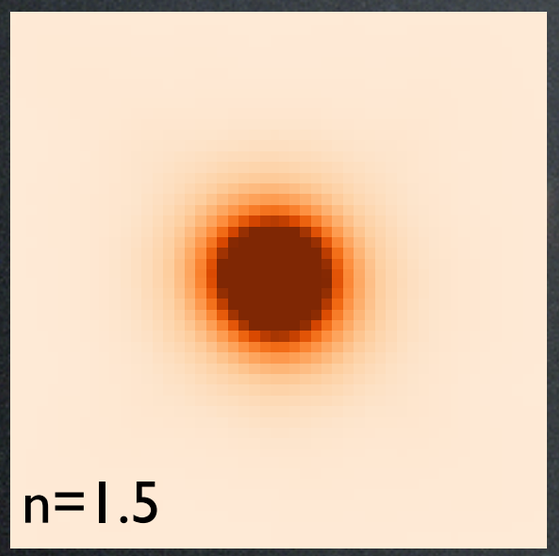


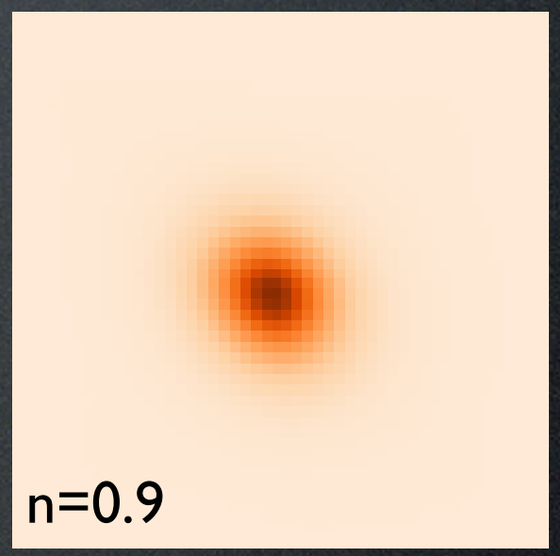


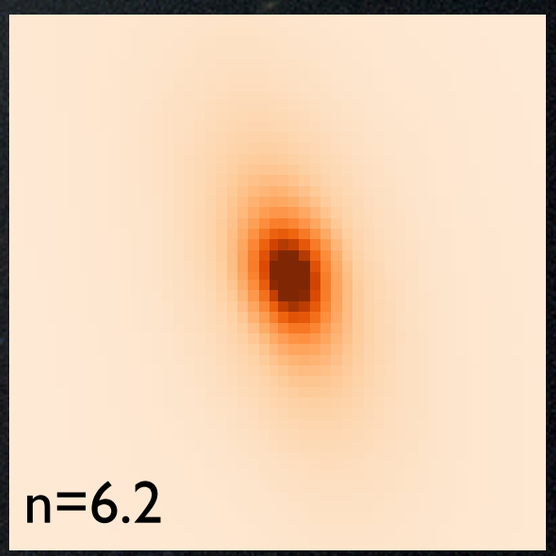








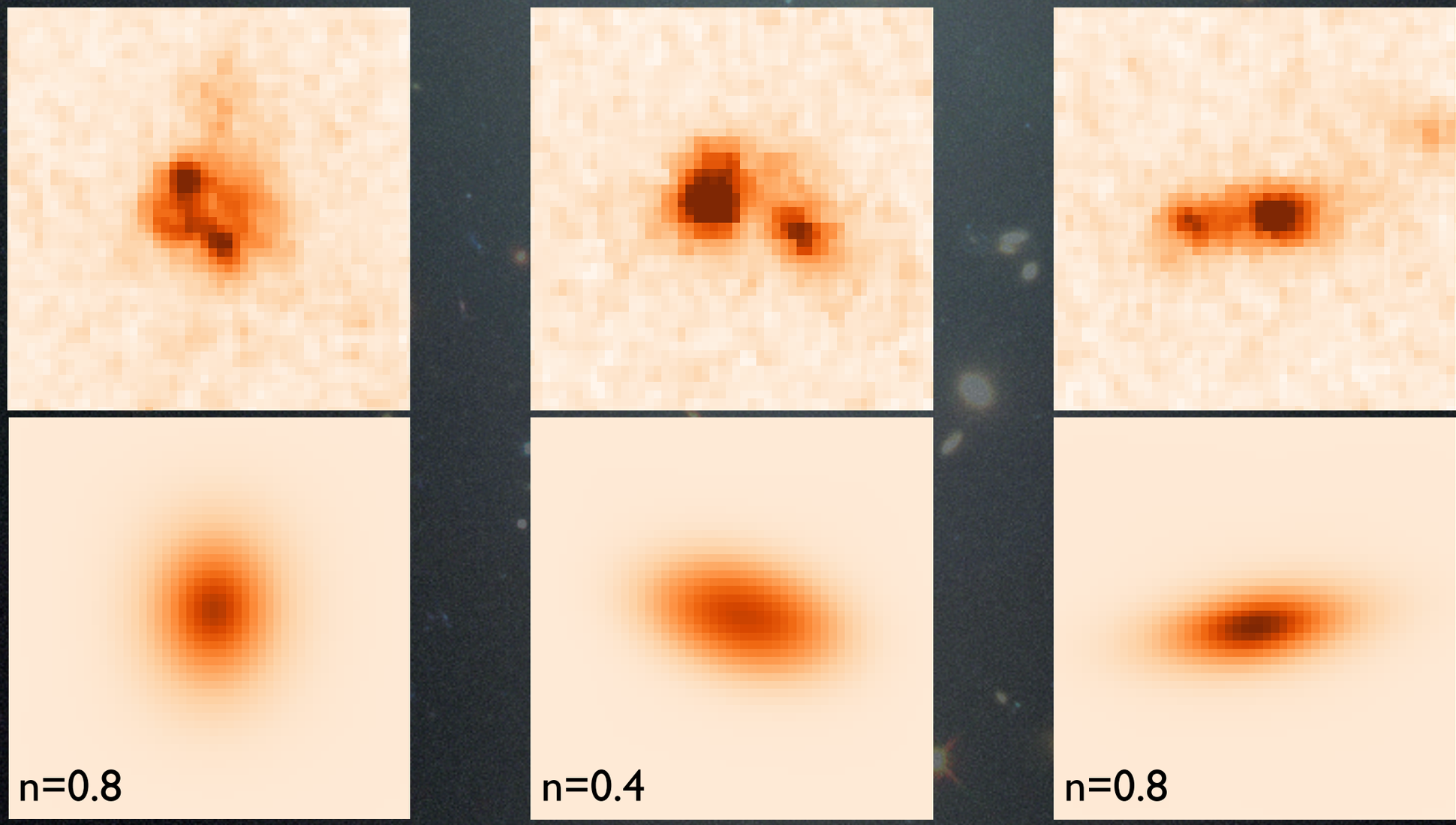




Red emitters are likely to be dusty starburst galaxies,
but they don't show the evidence of major merger/interaction.

WFC3 H_{160} images

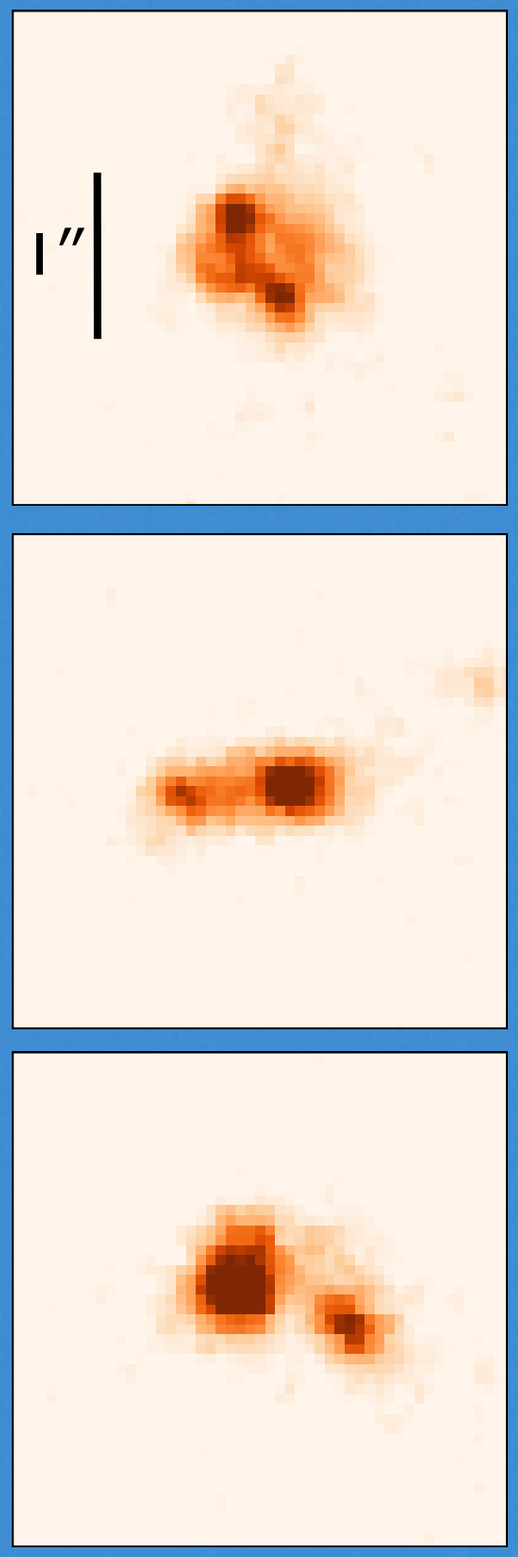
Red and MIPS-detected Hα emitters ($10^{10.5}M_\odot < M_{star} < 10^{11}M_\odot$)



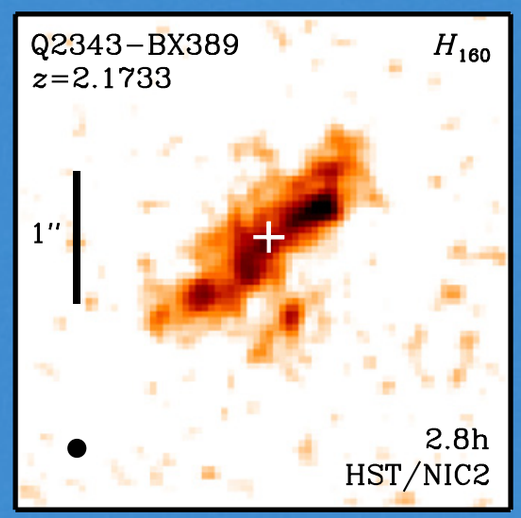
multiple → merger or clump ?

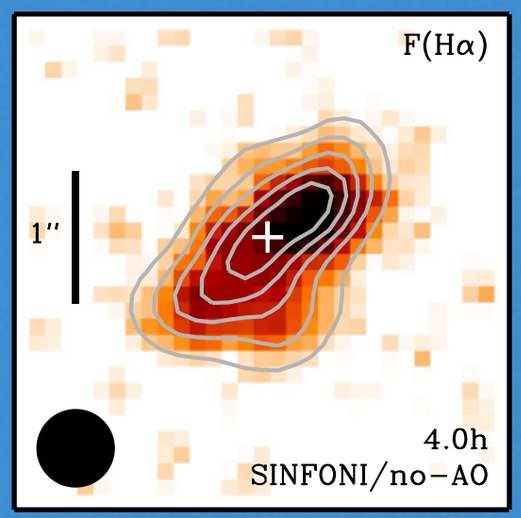
Merger or Clump ?

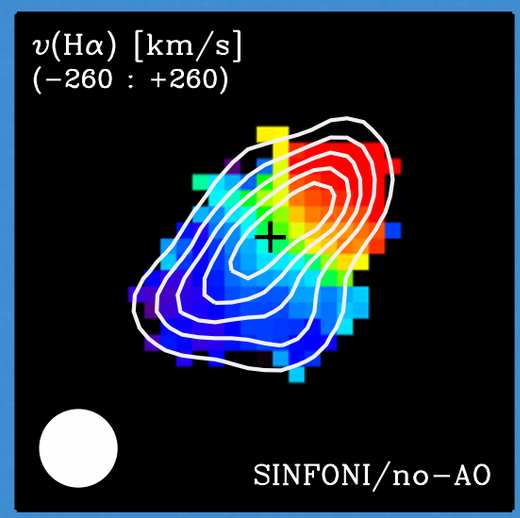
Our sample

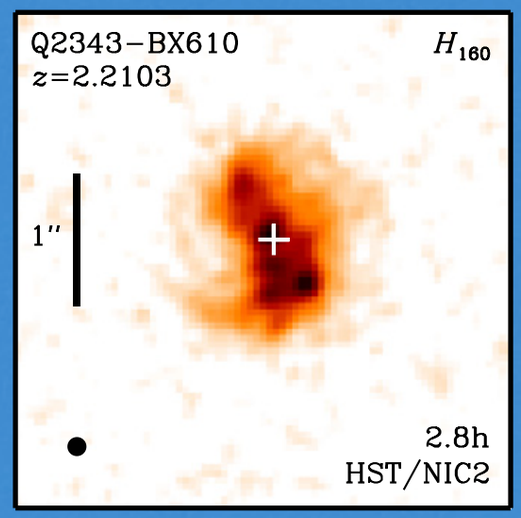


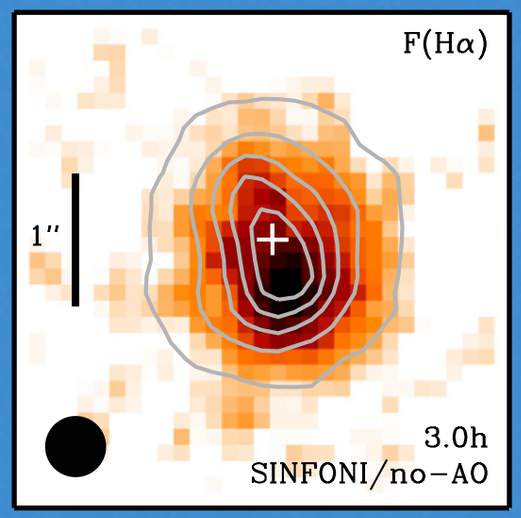
Forster Schreiber et al. 2011

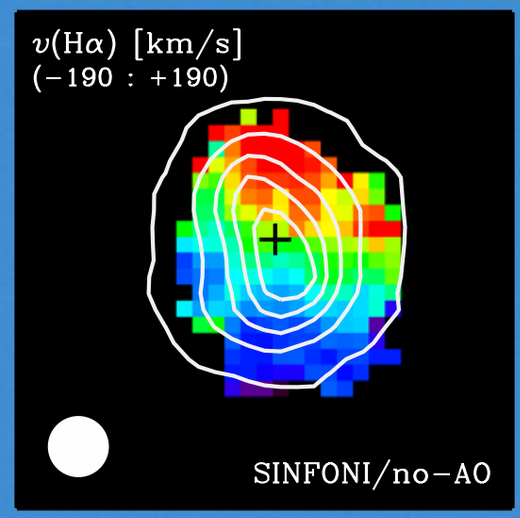


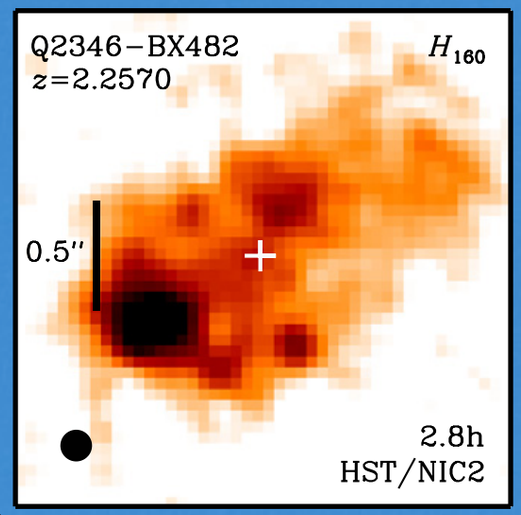


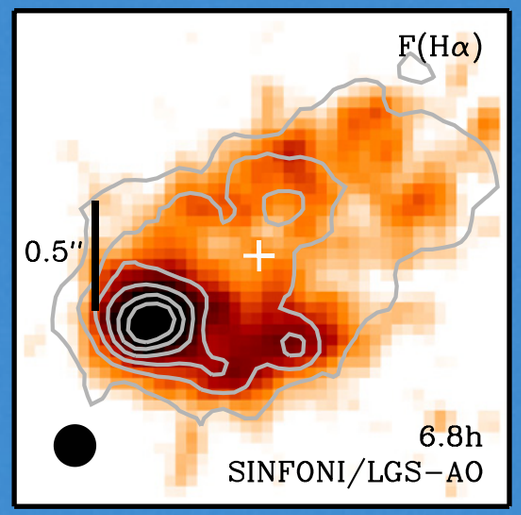


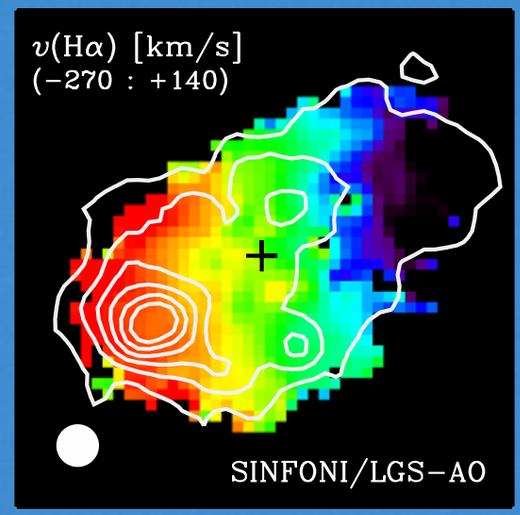






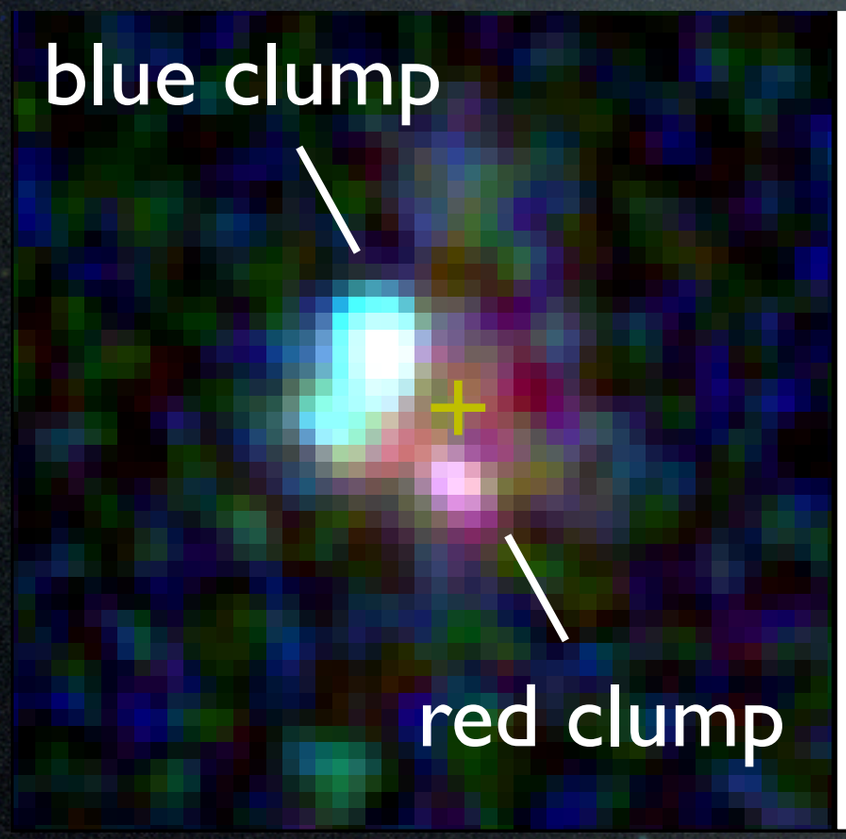




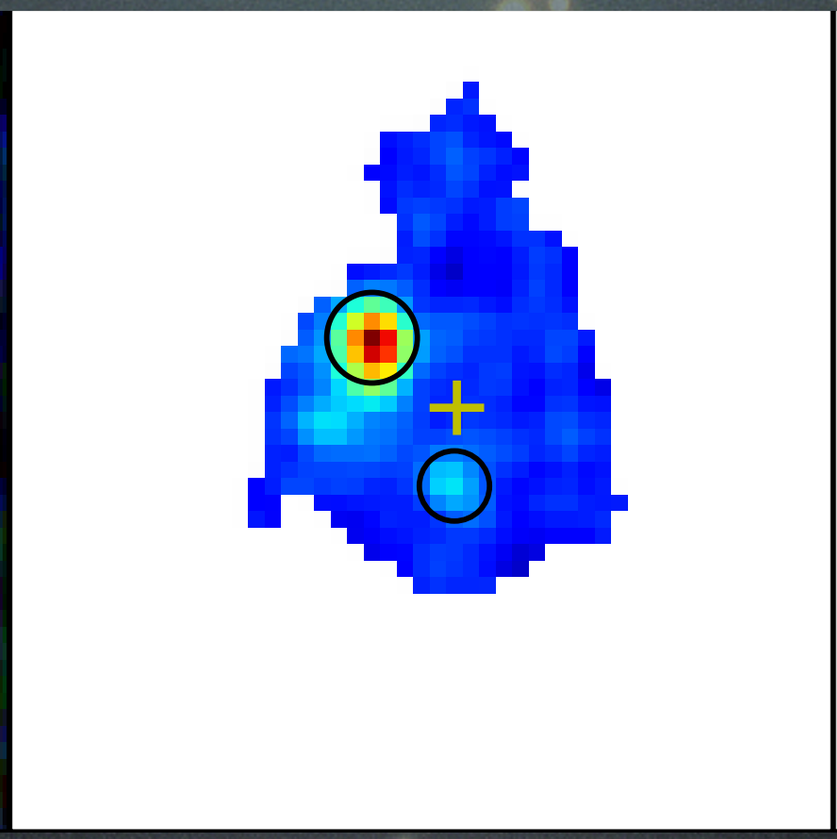


Clump Analysis

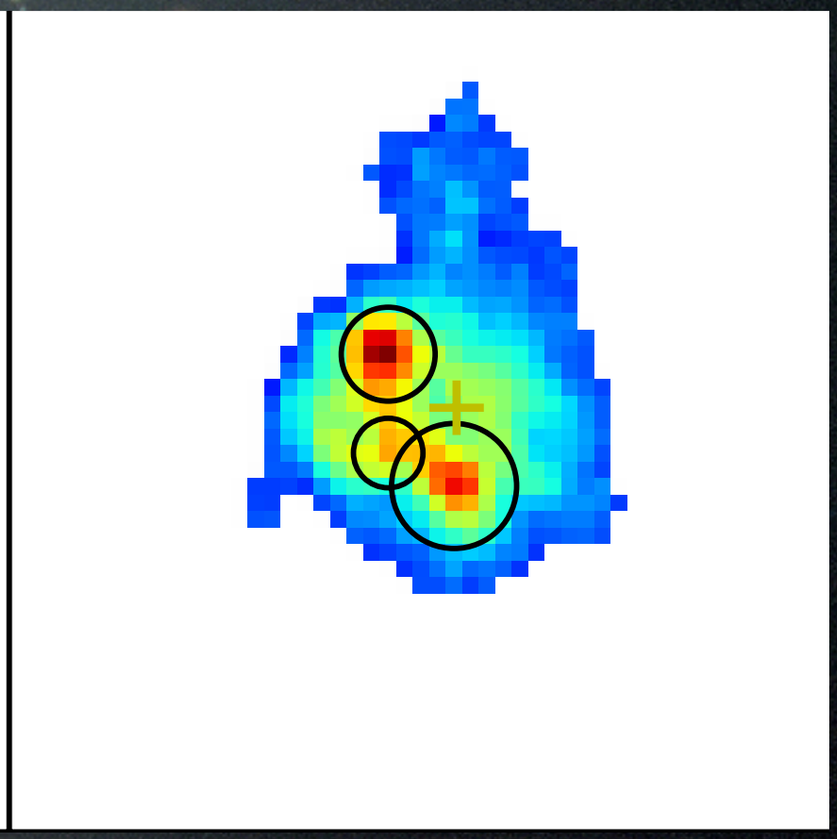
color image (V_{606},i_{814},H_{160})



ACS i_{814}



WFC3 H_{160}

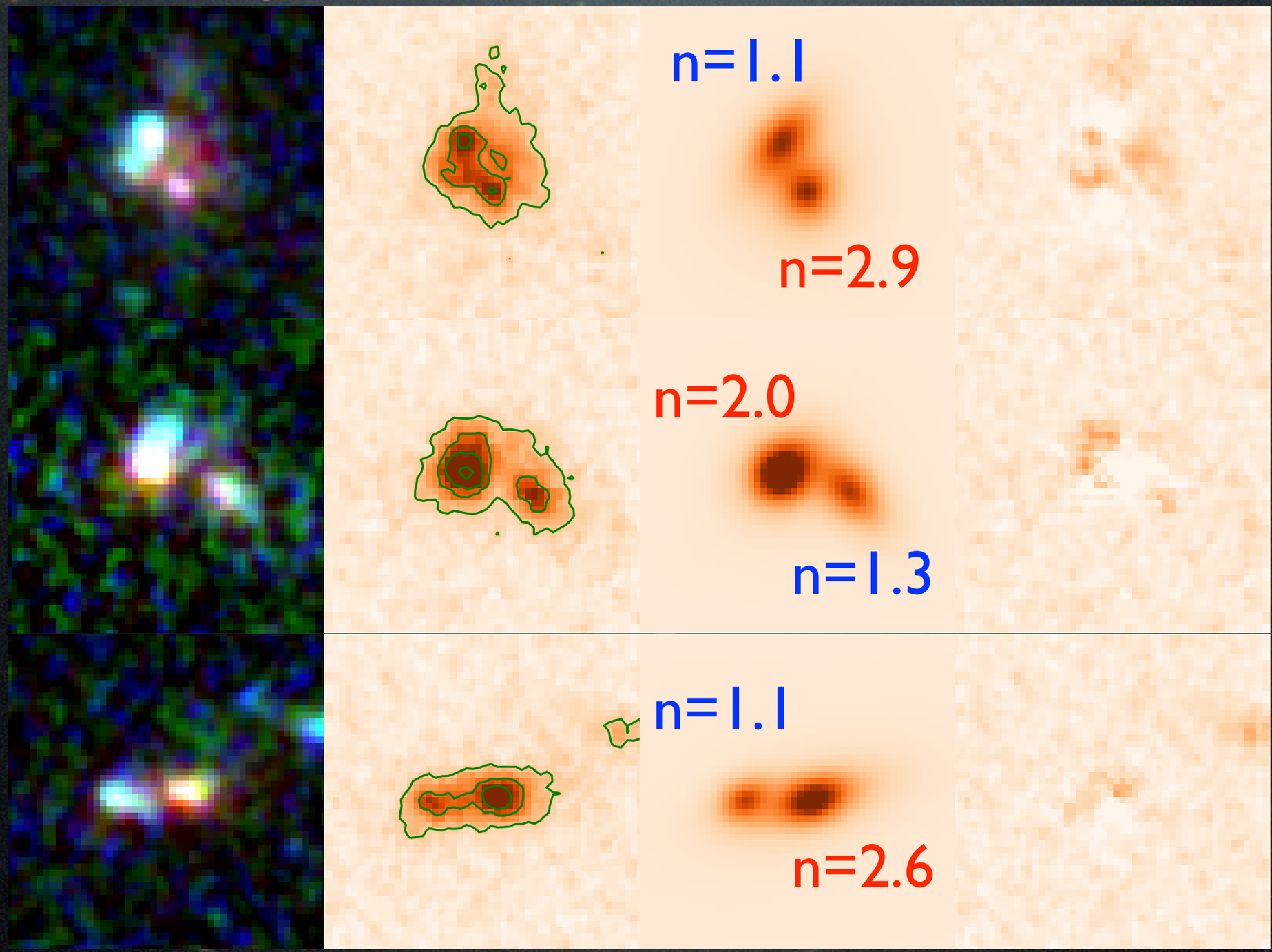


Red Hα emitter consists of red clump and blue clump !

→Red color is coming from this red clump.

2-component Models with GALFIT (Peng+10)

color image | H_{160} | model | residual



The profiles of red clumps show a higher sersic index (n>2) !

Summary

We investigated the morphologies of red Hα emitters.

1. red Hα emitters with $M>10^{11}M_{\odot}$

single core + entirely red + low sersic index
→extreme case of disk star-forming galaxies

2. red Hα emitters with $10^{10.5}M_{\odot}<M<10^{11}M_{\odot}$

pair of red and blue clump + high sersic index
→intense star-formation is triggered by minor merger or clump migration

How about in protocluster environments ?
MAHALO-sample will directly reveal it !