

Red Star Forming Galaxies in Distant Cluster Outskirts

~ A key population for understanding environmental effects at $z < 1$ ~

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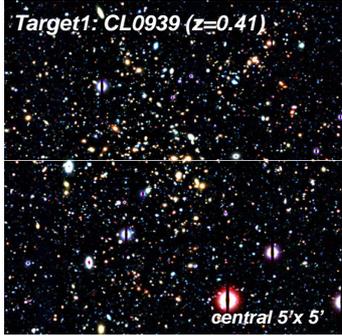


ABSTRACT

We present our panoramic H α emitter survey for the two distant clusters of galaxies at $z=0.4$ (CL0939+4713) and $z=0.8$ (RXJ1716+6708), with narrow-band filters of Suprime-Cam and MOIRCS on the Subaru Telescope. Taking advantage of the wide-field capability of these facilities, we investigate in detail the star forming activity of galaxies along the large-scale structures at these high redshifts. In particular, **we report a discovery of a surprisingly large number of optically red H α emitters in the cluster surrounding environment such as groups and filaments**, where the colour-density relation shows an abrupt break (i.e. transitional environment). We revealed that a non-negligible fraction of such red H α emitters are indeed MIR-detected dusty starbursts, based on our wide-field 15 μ m imaging with the AKARI satellite. Thus, our results demonstrate that properties of galaxies are indeed changing "before" entering cluster environment accompanying strong dusty starbursts, and that the group-scale environment at $z < 1$ has probably played a key role in shaping at least a fraction of the present-day cluster galaxies.

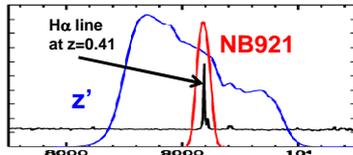
Target 1. The CL0939+4713 Cluster at $z=0.41$

Koyama et al. 2011, ApJ, 734, 66



main result 1

- A large number of H α emitters have been identified along the large-scale structure around the CL0939 cluster.
- A significant fraction (>30%) of H α emitters **in groups** show red colour (probably in transitional phase), suggesting an important role of the group environment for triggering/accelerating galaxy evolution.



What we did ?

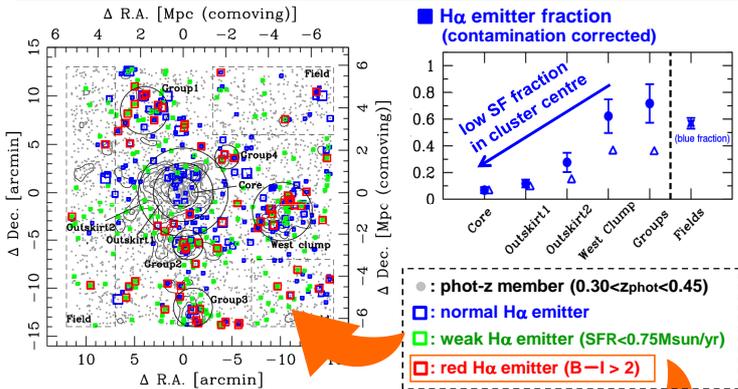
- We performed a wide-field H α emitter survey for the CL0939 cluster at $z=0.41$ using NB921 filter of Suprime-Cam/Subaru.

- The purpose is to map out the star forming activity along the large-scale structure, and to understand the environmental effects acting on galaxies in the cluster surrounding regions (i.e. transitional environment).



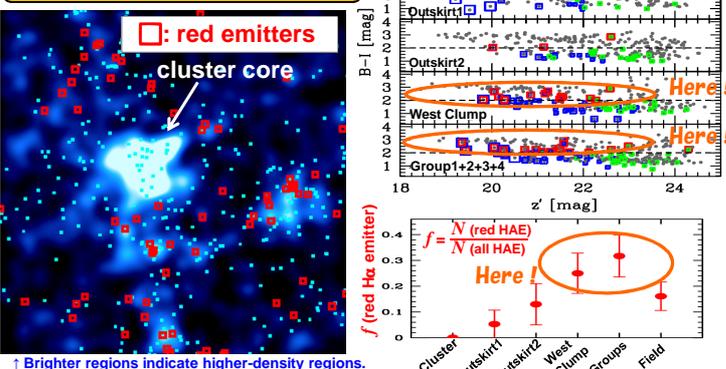
Panoramic H α view of the CL0939 cluster

The H α emitters are distributed widely along the large-scale structure, and the number of H α emitters decreases towards the cluster centre.



Red H α emitters in the group environment

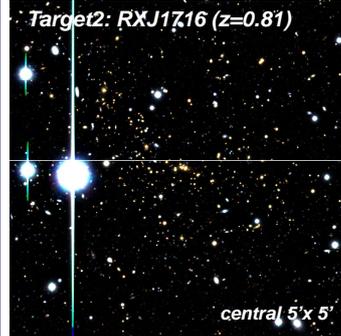
Obviously, the "red H α emitters" (transitional population) are most frequently seen in clump/groups (not in the cluster core!).



Brighter regions indicate higher-density regions.

Target 2. The RXJ1716+6708 cluster at $z=0.81$

Koyama et al. 2010, MNRAS, 403, 1611



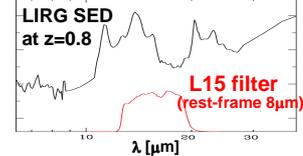
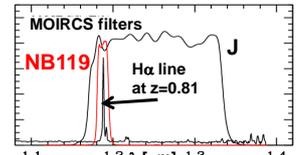
main result 2

- At least a part of red emitters around the RXJ1716 cluster are indeed MIR-detected dusty starbursts (not just gradually fading their star formation).
- Highly obscured galaxies with SFR(IR)/SFR(H α) > 3 are concentrated in the "medium-density" groups and filaments, supporting a link between dusty galaxies and such environment.

What we did ?

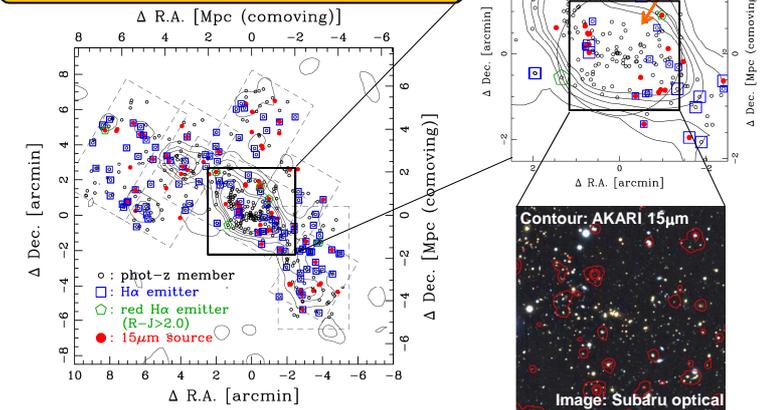
- We carried out the first wide-field H α and MIR mapping of a $z \sim 0.8$ cluster with MOIRCS/Subaru and the AKARI satellite.

- These observation allowed us to study both unobscured/obscured star formation activity in various environments around the cluster.



Panoramic H α +MIR view of the RXJ1716 cluster

The spatial distribution of the H α emitters and 15 μ m sources are very similar, and they avoid the cluster central region.



Dusty galaxies around the RXJ1716 cluster

Dusty red SF galaxies (red H α emitters and/or MIR sources) are concentrated in the "medium-density" groups/filaments.

