A discovery of Red Star Forming Galaxies in Groups at $z = 0.4$

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In the present-day Universe, galaxy properties are strongly correlated with the environment where the galaxies reside. For example, high-density environment such as clusters are dominated by red ellipticals and S0s, while general field environments are dominated by blue star-forming spirals or irregulars [1]. In order to study the origin of this environmental dependence of galaxy properties, the most direct and useful approach is to observe distant clusters of galaxies, because distant clusters are the young stage of present-day clusters where we can see active assembly of galaxies in the past Universe. In particular, wide-field observations of distant clusters enable us to unveil filamentary large-scale structures around the clusters [2], and to investigate the galaxy properties in such intermediate-density environment. Some previous studies with Subaru Telescope have shown that galaxy colours are strongly changing from blue to red in such cluster surrounding environment, and suggested that the cluster surrounding structures are key for understanding galaxy evolution (but not yet fully cultivated) [3,4,5]. Therefore, in order to study galaxy activities in such key environment more in detail, we heve carried out an Hα-based star-forming galaxy survey of the CL0939+4713 cluster (Abell 851) at $z = 0.41$ [6].

The Abell 851 cluster was studied with the Prime Focus Camera on Subaru (Suprime-Cam) [3], and a huge structure over ~10 Mpc has been identified around the cluster. Fortunately, the Hα line (rest-frame 6563 Å) from this cluster can be neatly captured by the narrowband filter NB921 (λ_c =9180 Å) on Suprime-Cam. Combining the available broad-band data (*BVRIz'*), we have identified more than 400 Hα emitting galaxies with star formation rates of >0.3 $M_\odot$/yr along the large-scale structure (Fig. 1). An intriguing finding from this survey is the colours of the Hα emitters: the majority of them show blue colours reflecting their young stellar population (as expected), while we find a non-negligible fraction of them show red colours with $B - I > 2$. Such red Hα emitters are expected to be dust-reddened star forming galaxies (dusty starbursts), and they are probably in the transitional stage from blue star forming population to red quiescent one. We find that the red Hα emitters are very rare in the cluster central region (within ~1 Mpc from the cluster centre), while as can be seen in Fig. 1 they are most strongly concentrated in group-scale environment which are located far from the cluster (we find that ~30 % of star forming galaxies in groups show red colours). This result shows that dusty starbursts are triggered in the group-scale environment (rather than highest-density cluster core), and suggests that this strong activity is related to the acceleration of galaxy evolution in distant group environment. We finally stress that this study provides us with an important clue on cluster galaxy evolution, and this is a great achievement of Subaru Telescope with wide-field of view.

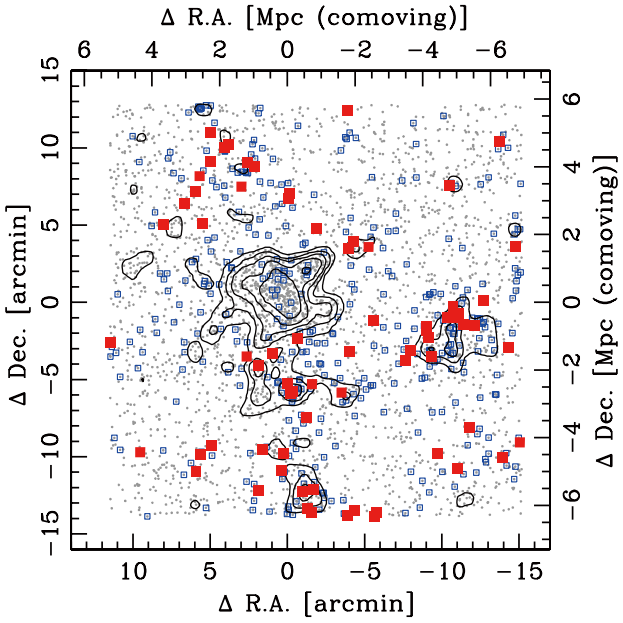

Figure 1: The large-scale structure around the Abell 851 cluster at z = 0.41, revealed by Suprime-Cam imaging. The grey dots show the photo-z selected members and the contours are drawn based on the surface number density of member galaxies. The red and blue squares indicate the red and blue Hα emitters, respectively. It is clear that the "red emitters" are preferentially found in the group-scale environment located far away from the cluster core.

References

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