MULTIWAVELENGTH STUDY OF THE GALAXY POPULATION IN THE YOUNG GALAXY CLUSTER RXJ1257+4738 AT Z=0.866

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ABSTRACT

We study the IR properties of galaxies in the young massive galaxy cluster RXJ1257+4738 at z=0.866, and their relation with the environment, by combining new observations of the GLACE survey (Sánchez-Portal et al. 2012)(broad band imaging with GTC-OSIRIS & WHT-LIRIS) and Hershel-PACS&SPIRE imaging photometry, along with existing Spitzer-IRAC&MIPS data. With this wide wavelength coverage, we derived photometric redshifts throught a SED-fitting procedure to obtain 96 cluster candidate galaxies with an accurately sample of the IR peak. The analysis of the star formation activity of these cluster member galaxies show no clear relation with local density. From a global point of view, we find that RXJ1257 properties are consistent with the mass-normalized total SFR evolution with redshift.

CATALOG: CLUSTER MEMBER CANDIDATES

Aimed at building a merge catalog including all detected sources, we performed a cross-match of individual catalogs, from optical to FIR, by applying a criterion of minimum sky distance. A quantitative analysis of our procedure, with the methodology of de Ruiter et al. (1977), gives us completeness and realibility values above 90% and 80%, respectively. The resulting raw catalog has 7226 sources. To compute the redshift for all galaxies in the sample we carried out a SED-fitting using the *LePhare* code (Ilbert et al. 2006). We obtained 651 galaxies with $0.8 < z_{phot} < 0.95$, of which 96 have their IR part of the SED well fitted. *LePhare* directly gives as output the age, stellar mass, IR and UV luminosities and extinction of the galaxies. We derived the total SFR, using Kenicutt (1998) calibrations, as the sum of $SFR_{UVuncorrected}$ plus the FIR contribution.

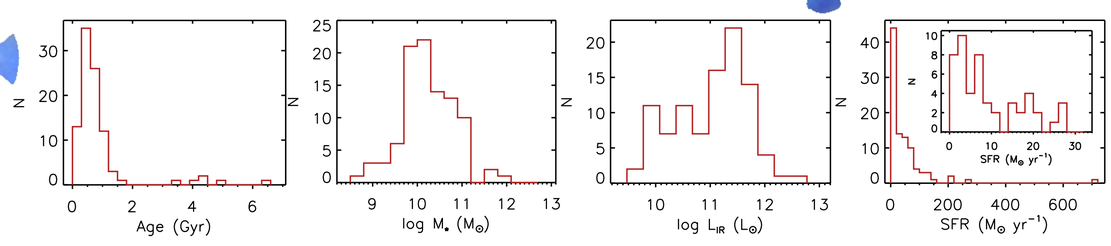

FIG.1. Physical properties for the 96 candidates for cluster galaxies obtained with a SED-fitting using the *LePhare* code.

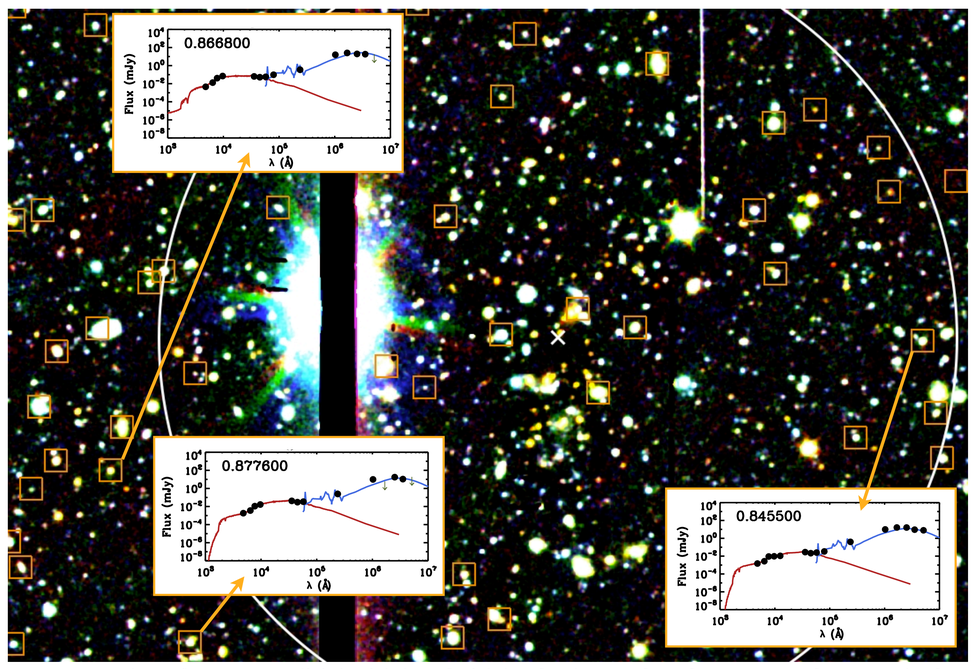

FIG.2. A section of an OSIRIS i' (R), r' (G) and g' (B) color image that shows some photometric cluster galaxies and examples of SED-fitting for 3 sources. The white circle is about one virial radii (2.3 arcmin).

LOCAL DENSITY RELATIONS

In order to study the environmental dependence of the star formation activity, we built the density-SFR and density-sSFR relations. We estimated the local density, Σ_5 (in Mpc^{-2} units), at each galaxy position using its neighbouring galaxies by calculating the surface of the circle whose radius equals the projected distance to the 5th nearest galaxy. In this calculation, all galaxies with z_{phot} in the range 0.8-0.95 are considered.

To distinguish the environmental and the mass effects, we analyzed two bins of stellar masses: the low mass sample with $M < 5x10^{10}M_{\odot}$ and the high mass sample with $M \geq 5x10^{10}M_{\odot}$. As in Popesso et al. (2011), the approach is to derive the mean density per SFR and per sSFR bins. In both samples we found no clear correlation between density and SFR or between density and sSFR, although we see that high mass systems tend to dominate high SFR bins while the low mass sample dominates high sSFR ones. A similar result is obtained if we estimate the mean SFR (and mean sSFR) per density bin, since as shown in figure below both relations are flat with a marked difference between mass samples.

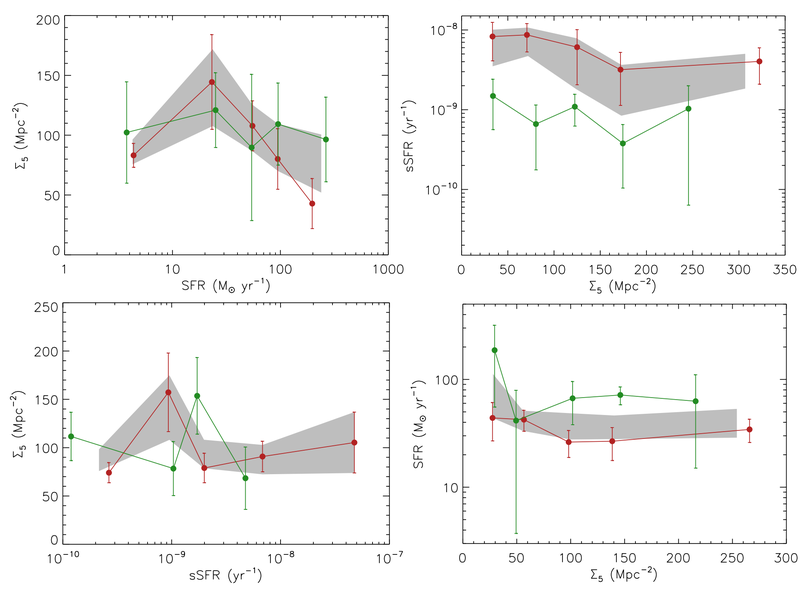

FIG.3. Density-SFR (*left*) and density-sSFR(*right*) relations. We show the relations obtained deriving the mean density per SFR and sSFR bin (*top*), and those obtained estimating the mean SFR and the mean sSFR per density bin (*bottom*). The global relation in each case is shown as a gray region, red circles represent the low mass sample and green circles the high mass one. Error bars were calculated using the dispersion around the mean in each bin divided by the square root of the number of galaxies in the bin.

GLOBAL EVOLUTION

We characterize the RXJ1257 cluster SFR properties in terms of the mass-normalized total SFR, $\sum SFR/M_{cl}$, to compare them with previous studies in the literature. Following Finn et al. (2005), we estimate $\sum SFR$ using all the cluster member galaxies within $0.5xR_{200}$, and divide it by M200 to derive $\sum SFR/M_{cl}$. Both parameters, R200 and M200, are calculated based on a velocity dispersion of 600Km/s (Ulmer et al. 2009).

In the plots below, we include our cluster in the sample compiled by Koyama et al.(2010); we see how the mass-normalized total SFR increases towards higher redshift clusters. Although the scatter is large, this evolutionary trend with redshift can be fitted with $(1+z)^6$. This global cluster property is also well correlated with cluster mass, which can cause the scatter amog clusters at a similar redshift, implying that a wide range of masses in each redshift bin is needed to understand the evolution of starforming activity in clusters.

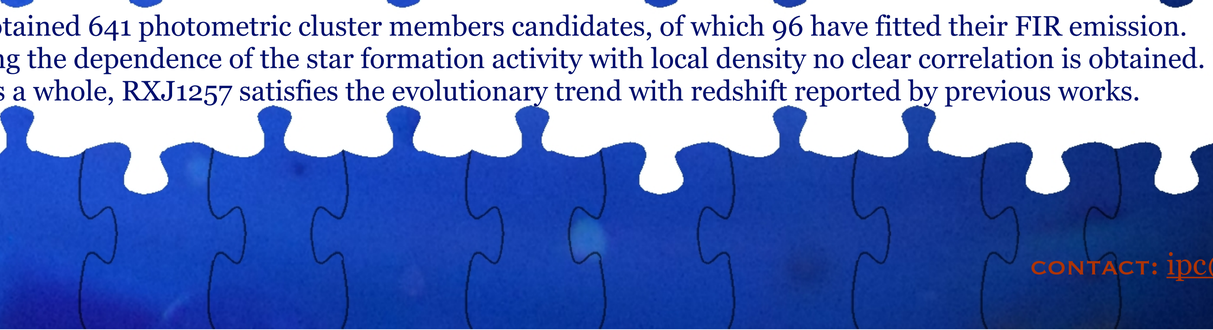

FIG.4. $\sum SFR/M_{cl}$ as function of redshift (*left*) for RXJ1257 (blue circle) with other clusters in Koyama et al. (2010) based on Hα measures (red triangles) and based on MIR measures (red circles). Lines shows models from Koyama et al (2010) (red) and from Popesso et al. (2011) (green). Relation between $\sum SFR/M_{cl}$ and the cluster mass (*right*) followed by both high (filled circles) and low (open circles) redshift clusters. Green line shows the anticorrelation found by Bai et al. (2009).

RESULTS

(1) We obtained 641 photometric cluster members candidates, of which 96 have fitted their FIR emission.
(2) Studying the dependence of the star formation activity with local density no clear correlation is obtained.
(3) As a whole, RXJ1257 satisfies the evolutionary trend with redshift reported by previous works.

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