A Census of Mid-Infrared Selected AGN in Massive Galaxy Clusters at $0 \leq z \leq 1.2$

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Introduction

Our goal is to study the prevalence and properties of *Spitzer* IRAC selected AGN in cluster type environments over a broad redshift range. The initial sample consists of nine massive, X-ray luminous galaxy clusters (Saintonge et al. 2008) hosting 1517 galaxies confirmed with optical spectroscopy, 949 of which are detected in the 4 IRAC channels. We complement our analysis with data from catalogs of optical photometry & morphology and X-ray observations.

Cluster Properties

Cluster	$\langle z \rangle$	N_z	$N_{\rm IRAC}$
Coma	0.02	348	262
Abell 1689	0.18	81	73
MS 1358+62	0.33	171	133
CL 0024+17	0.39	205	75
MS 0451−03	0.54	242	90
MS 2053−04	0.58	132	87
MS 1054−03	0.83	153	120
RX J0152−13	0.84	147	80
RDCS J1252−29	1.24	38	29

We identify 12 galaxies that satisfy mid-IR color criteria for AGN classification[1]. We find our IR-AGN to be predominantly hosted by blue, late-type galaxies in agreement with recent studies[2]. Four of our IR-AGN are also detected as X-ray AGN that are located ≥0.5 Mpc from their cluster centers (figure 1) and are the most infrared luminous (figure 2).

To compare AGN fractions among our clusters, we create two samples: (1) an optically complete sample with galaxies at $V_{(AB)} < -21.5$ and (2) a mid-IR complete sample based on the evolution of the [3.6] μm luminosity function[3] (see figure 3).

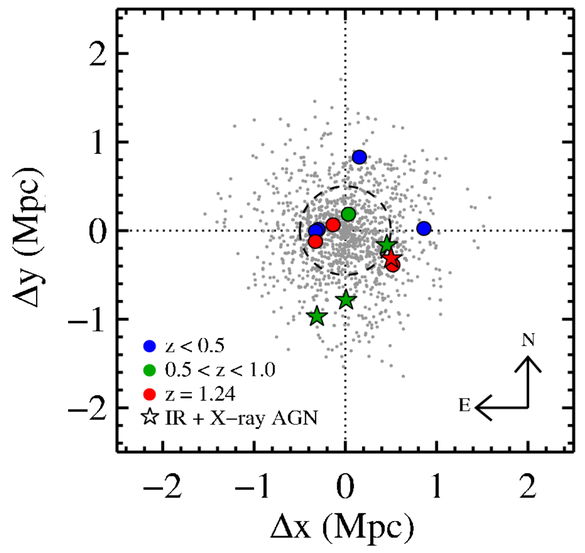


Figure 1: Projected locations of cluster galaxies relative to their cluster centers. IR-AGN are shown as filled circles & stars. The dashed circle shows a cluster-centric radius of 0.5 Mpc. **IR-AGN seem to show no preference for lying within the cluster center or in the outer regions.**

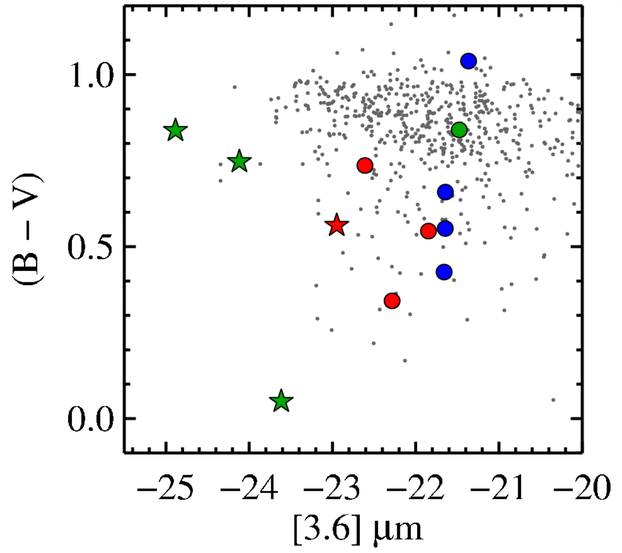


Figure 2: Rest frame color-magnitude relation for cluster galaxies. Symbols are the same as in figure 1. **IR-AGN tend to be bluer than red sequence galaxies. Also, IR + X-ray AGN tend to be the brightest galaxies at [3.6] μm.**

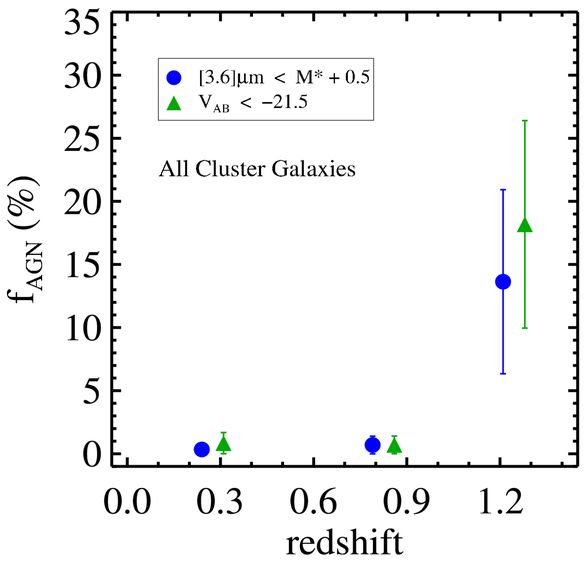
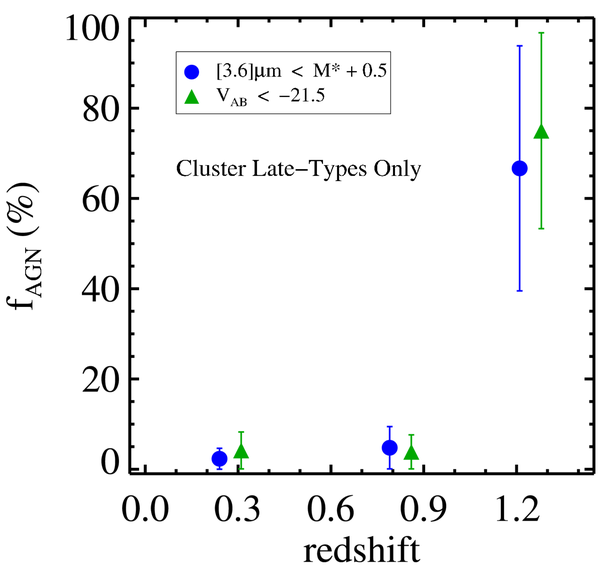


Figure 3 — IR-AGN Fractions

Fraction of galaxies that host an IR-AGN (f_{AGN}) as a function of redshift. We consider three redshift bins: low-z ($z < 0.5$), mid-z ($0.5 < z < 1.0$) and the last at $z = 1.24$ for RDCS 1252 only.

Left : Fractions from all cluster galaxies
Right : Fractions from only cluster late-types

Cluster late-type fractions were calculated because a bias could be introduced due to the tendency for IR-AGN to reside in late-type galaxies[2].



Overall, we find that the total cluster f_{AGN} is uniformly low (< 5%) in massive clusters except for RDCS 1252-29 at $z = 1.24$. This suggests that f_{AGN} only increases at $z > 1$ or that RDCS 1252-29 is an unusually active cluster. No other individual galaxy cluster exhibits an IR-AGN fraction > 5%.

References:
[1] Stern et al. 2005, ApJ, 631, 163
[2] Hickox et al. 2009, ApJ, 696, 891
[3] Muzzin et al. 2008, ApJ, 686, 966

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