

The Structural Properties of Cluster Galaxies at $z = 1.62$ and the Morphology-Density Relation

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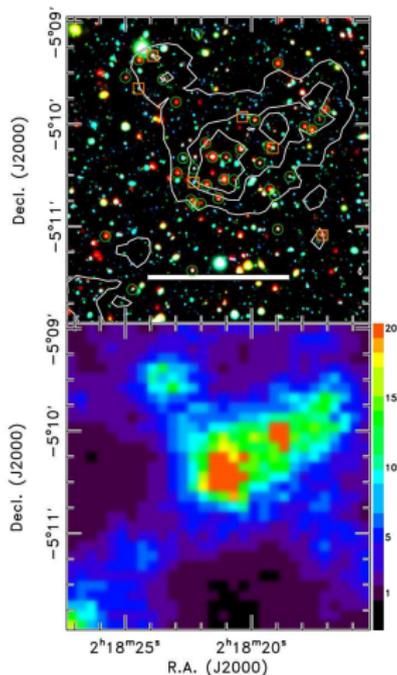
Texas A&M University
George P. and Cynthia Woods Mitchell Institute for Fundamental Physics and
Astronomy

Thanks to my CANDELS collaborators

Outline

- 1 Cluster Discovery
- 2 Data
- 3 Analysis
 - Papovich et al. 2012
 - Bassett et al. 2012 (submitted)
 - Other Clusters

Cluster Discovery



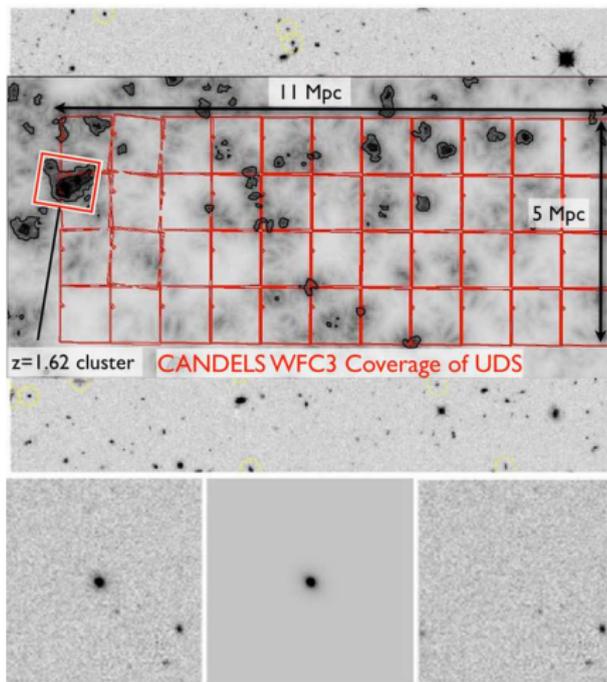
- Simultaneously discovered by Tanaka et al. and Papovich et al. in 2010.
- Discovered as an overdensity of galaxies with red IRAC $([3.6\mu] - [4.5\mu])_{AB}$ colors.
- Chandra reveals weak extended emission surrounding single dominant point source.
- Combined spectroscopy from both groups provides 13 galaxies with $1.62 < z_{sp} < 1.65$.

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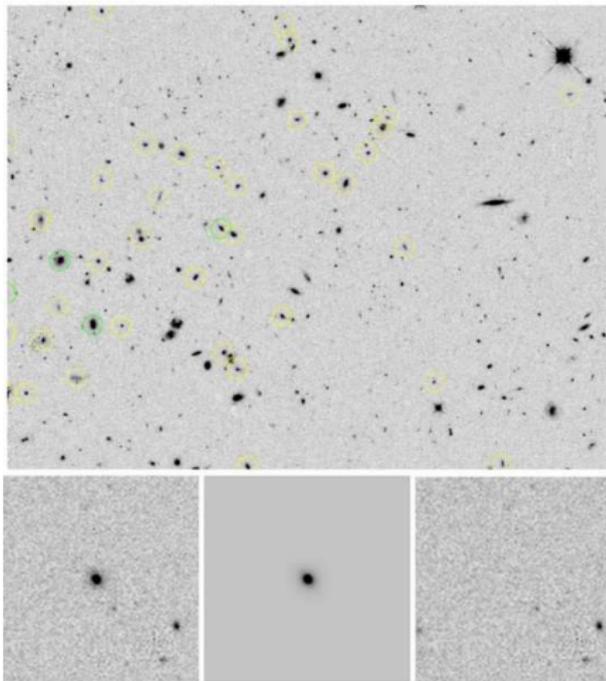
CANDELS Observations

- Typical CANDELS image from HST WFC3 F125W band (roughly B-band rest frame at $z=1.6$)
- Galaxy surface brightness profiles fit with GALFIT (Peng et al. 2002)
- Simulations using fake galaxies show GALFIT results to be accurate within 20% for typical galaxies in our sample to $\sim 23^{\text{rd}}$ magnitude



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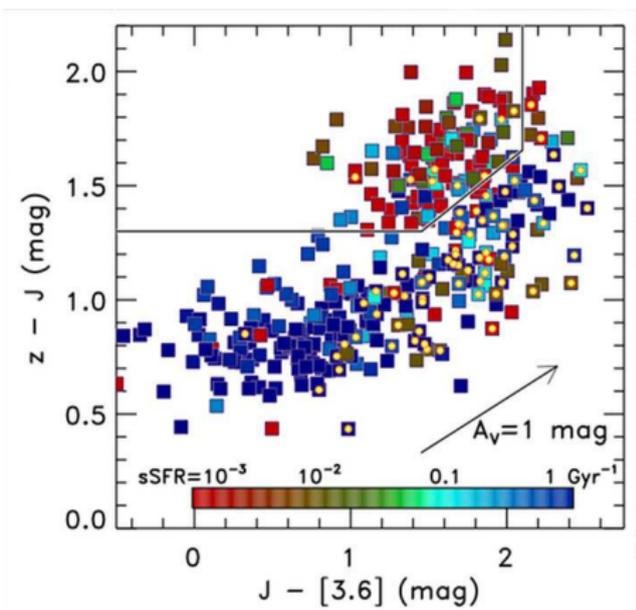
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Color-Color Selection of Quiescent Galaxies



Papovich et al. (2012)

We used a color-color selection based on $V - J$ versus $U - V$ as described in Williams et al. (2009) for this redshift:

$$(z - J)_{AB} \geq 1.3 \text{ mag}$$

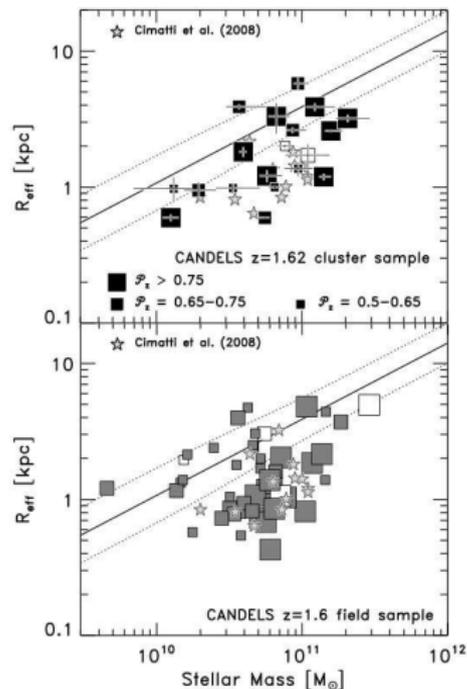
$$(J - [3.6])_{AB} \leq 2.1 \text{ mag}$$

$$(z - J)_{AB} \geq 0.5 + 0.55(J - [3.6])_{AB}$$

to select quiescent galaxies.

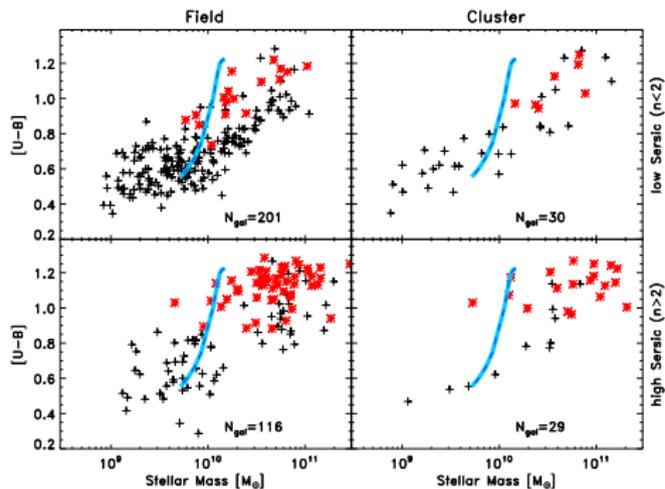
Environmental Dependence of Quiescent Galaxy Sizes

- Cluster defined as within 1.5 Mpc of the cluster core
- Field defined as outside 3.0 Mpc of the cluster core
- We find a lack of compact, quiescent galaxies in the cluster



Papovich et al. (2012)

Color-Stellar Mass Diagram

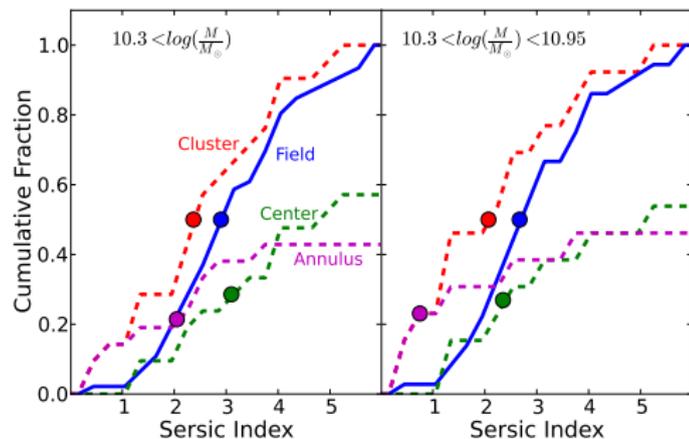


Bassett et al.
(submitted)

- There already exists a clear red sequence and a color-mass relation at this redshift.
- High Sérsic objects are more likely to be massive, red, and quiescent.
- Environmental effects appear weak contrasting with low redshift (for example, see Hogg et al 2004)

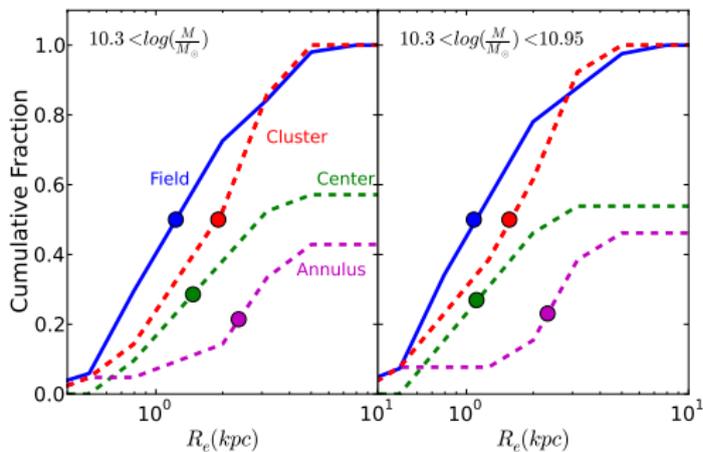
Environmental Dependence on Quiescent Galaxy Sérsic Indices

- Sérsic indices of cluster galaxies are *smaller* than those in the field.
- This trend is dominated by intermediate mass galaxies on the outskirts of the cluster.



Bassett et al. (submitted)

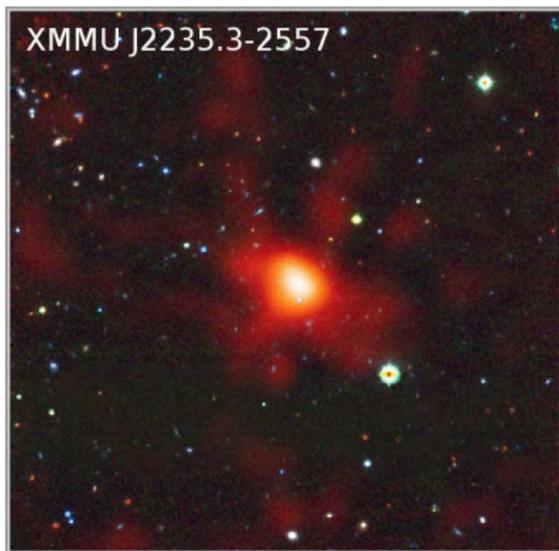
Environmental Dependence on Quiescent Galaxy Effective Radii



- Larger effective radii in the cluster are also dominated by galaxies in the outskirts
- These galaxies have sizes and structures more consistent with star forming disks

Bassett et al. (submitted)

Other Clusters



Mullis et al. 2005



Spitler et al. 2012

Summary

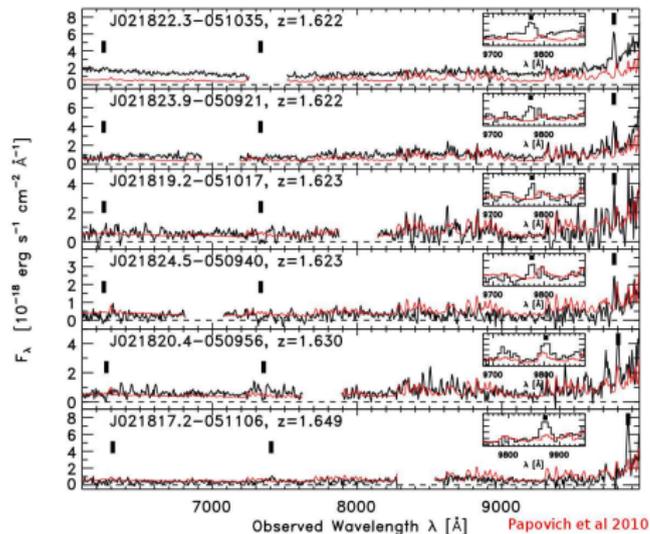
- Galaxy cluster detected as overdensity of red galaxies, likely still in process of virializing.
- Among quiescent galaxies, those found in the cluster are less compact and have larger effective radii.
- This trend is driven by galaxies in the outer regions of the cluster which are morphologically similar to star forming disks. This is likely an environmental effect.

Photometry

- All 4 Spitzer IRAC Bands
- UKIRT J & K
- Subaru B, R, i, and z
- Photometric Redshifts using EAZY
- SED fitting with BC03 on 10 band photometry



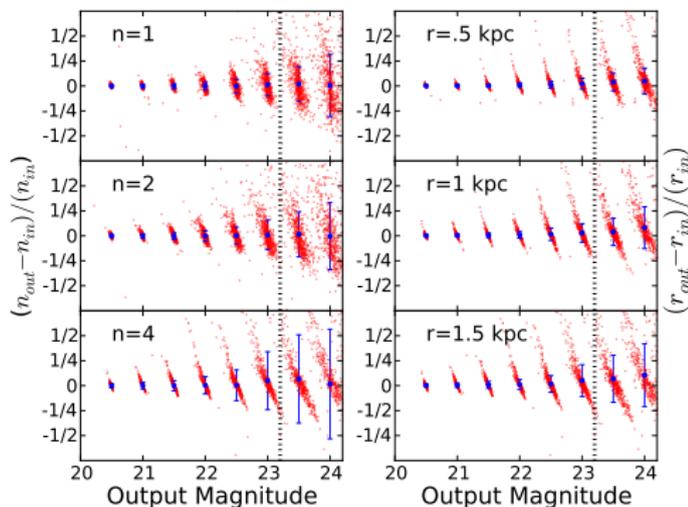
Spectroscopic Followup



- 24 likely cluster members were targeted by IMACS on Magellan
- Redshifts were measured for 11 of these objects based on [OII] emission
- Dynamical mass estimate from these observations is $\sim 4 \times 10^{14} M_{\odot}$

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