Different Views of Star Forming Galaxies in Protoclusters

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UNITED KINGDOM · CHINA · MALAYSIA

Overview

- What are protoclusters?
- A newly discovered protocluster at z=2.5
- What do the semi-analytics say?
- So, how overdense is an overdensity?
- Conclusions and Future Work

Collaborators

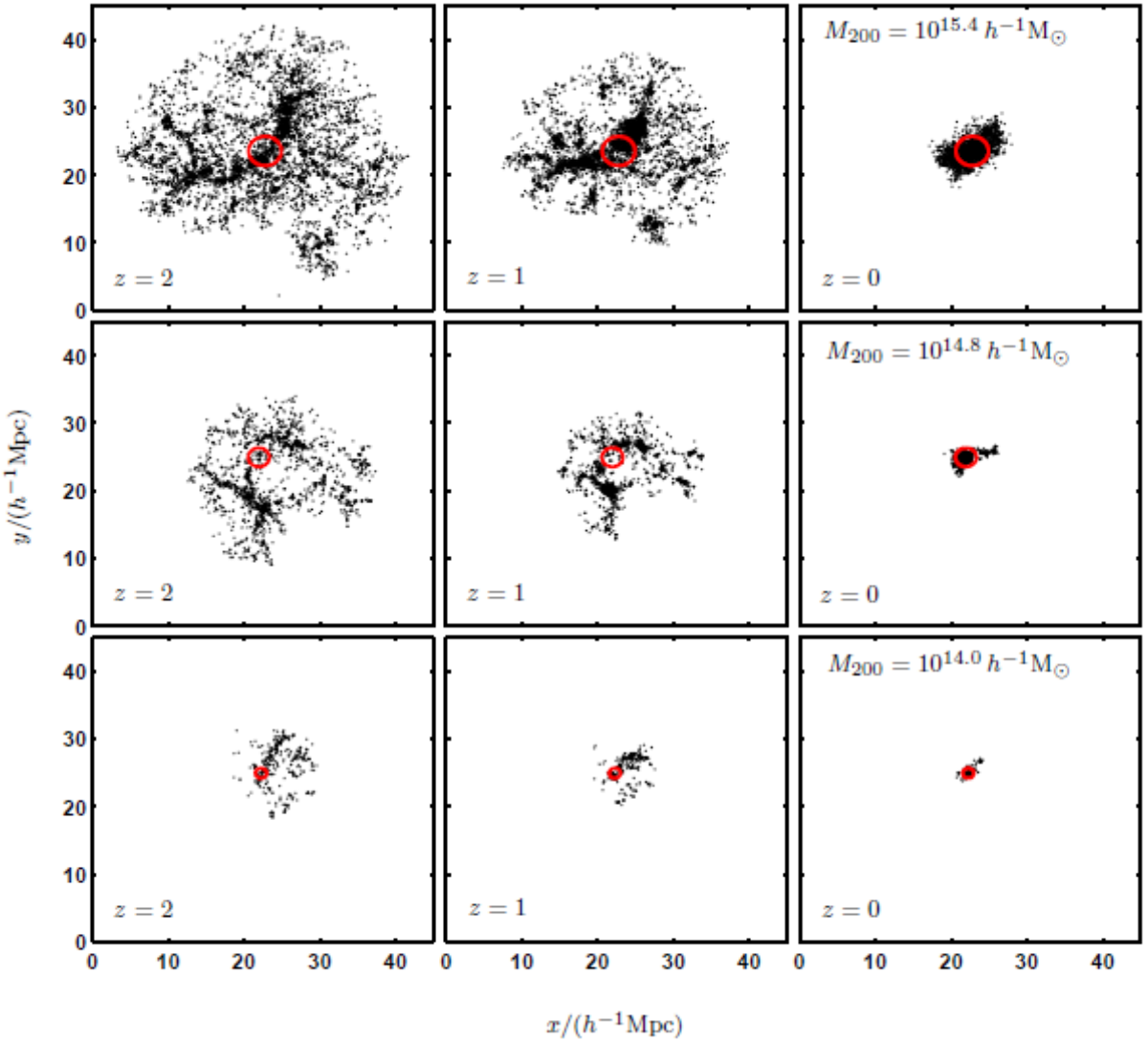
Elizabeth Cooke

Nina Hatch

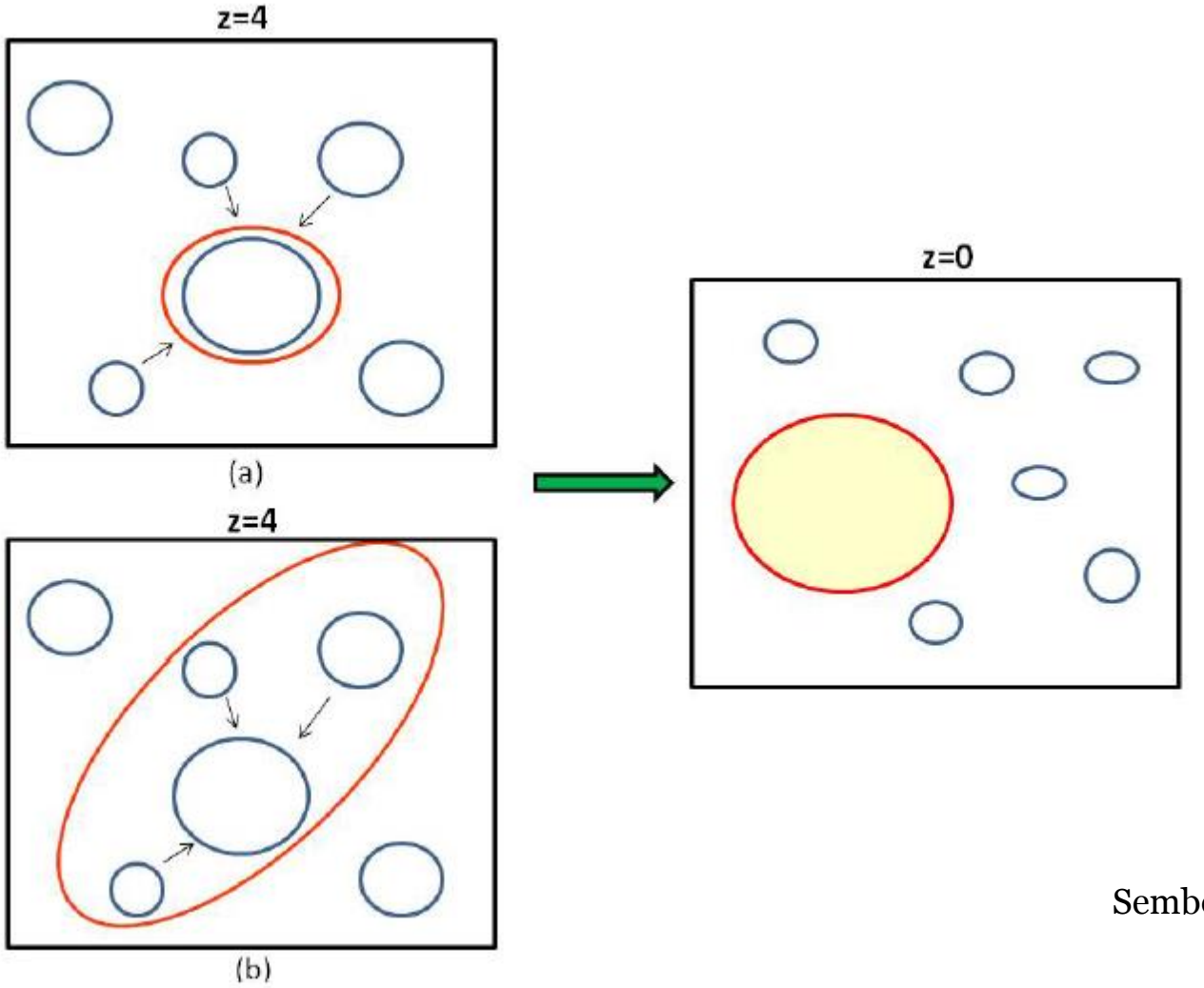
What is a protocluster?

THE EARLY ASSEMBLY OF GALAXY CLUSTERS

Cluster Formation



What is a Protocluster?



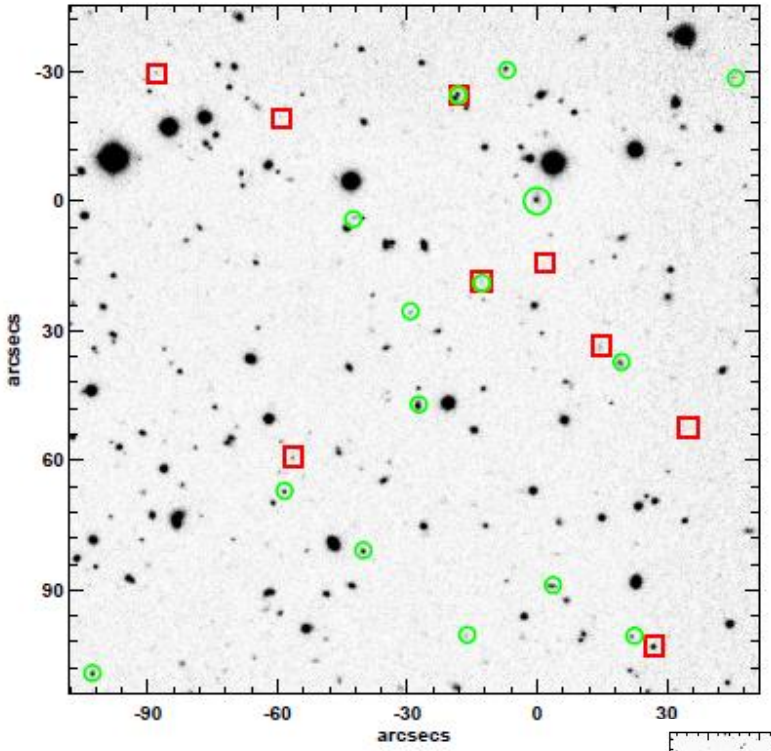
Sembolini et al. (2013)

A z=2.5 Protocluster

A NEWLY DISCOVERED PROTOCLUSTER AROUND THE RADIO GALAXY MRC2104-242

COOKE ET AL. (INC. MULDREW; SUBMITTED)

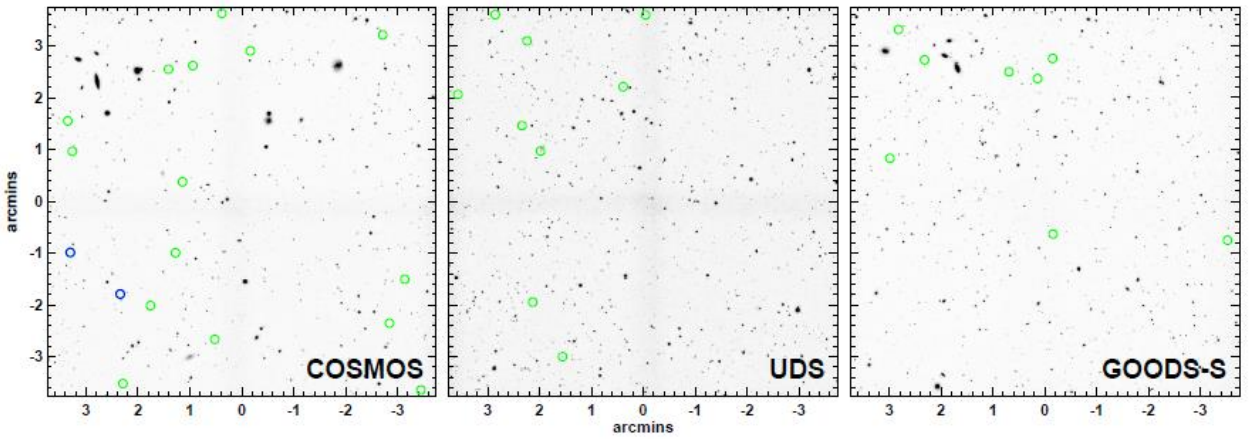
z=2.5 Protocluster



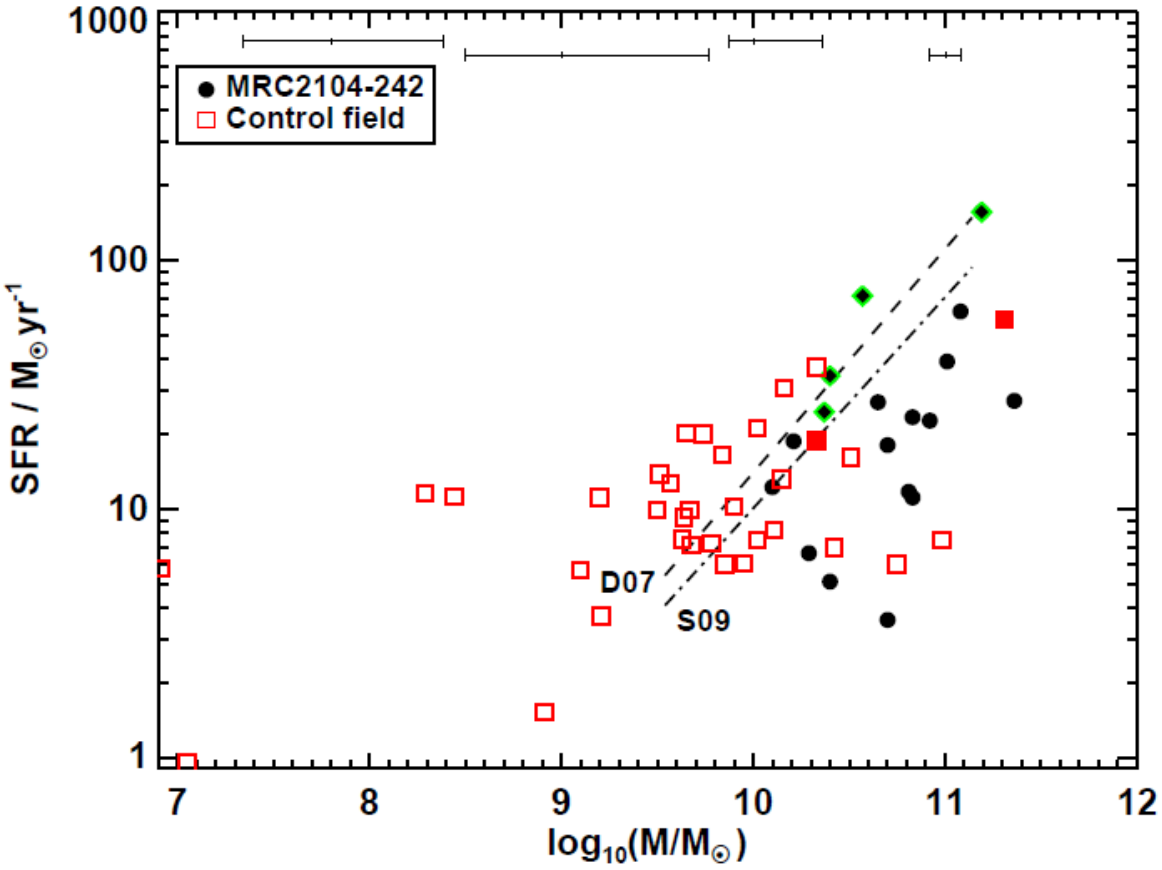
NB images, green circles are Hα sources

Left: 2.65 arcmin image around radio galaxy MRC 2104-242

Bellow: 7.5 arcmin image of control fields

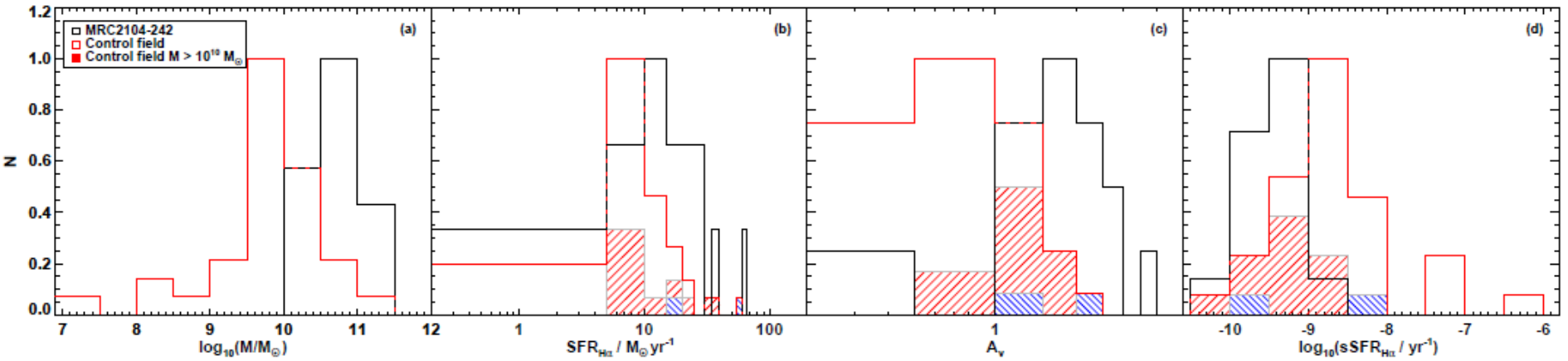


Star Formation Rate – Mass Relation

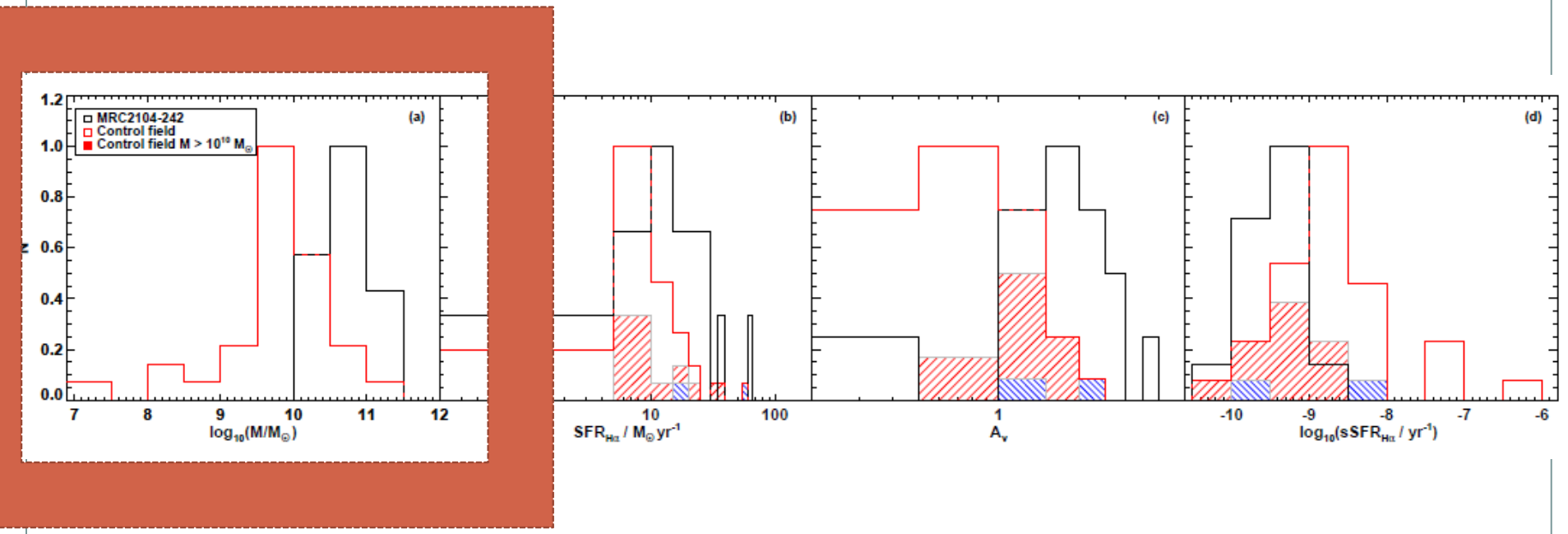


Daddi et al. (2007)
Santini et al. (2009)

Protocluster Galaxy Properties



Protocluster Galaxy Properties



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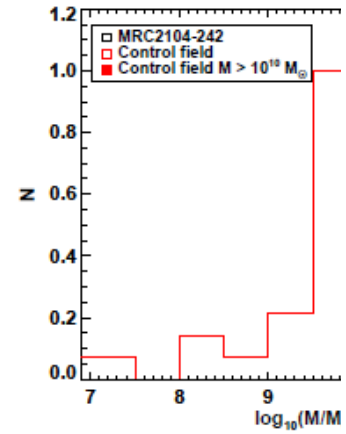
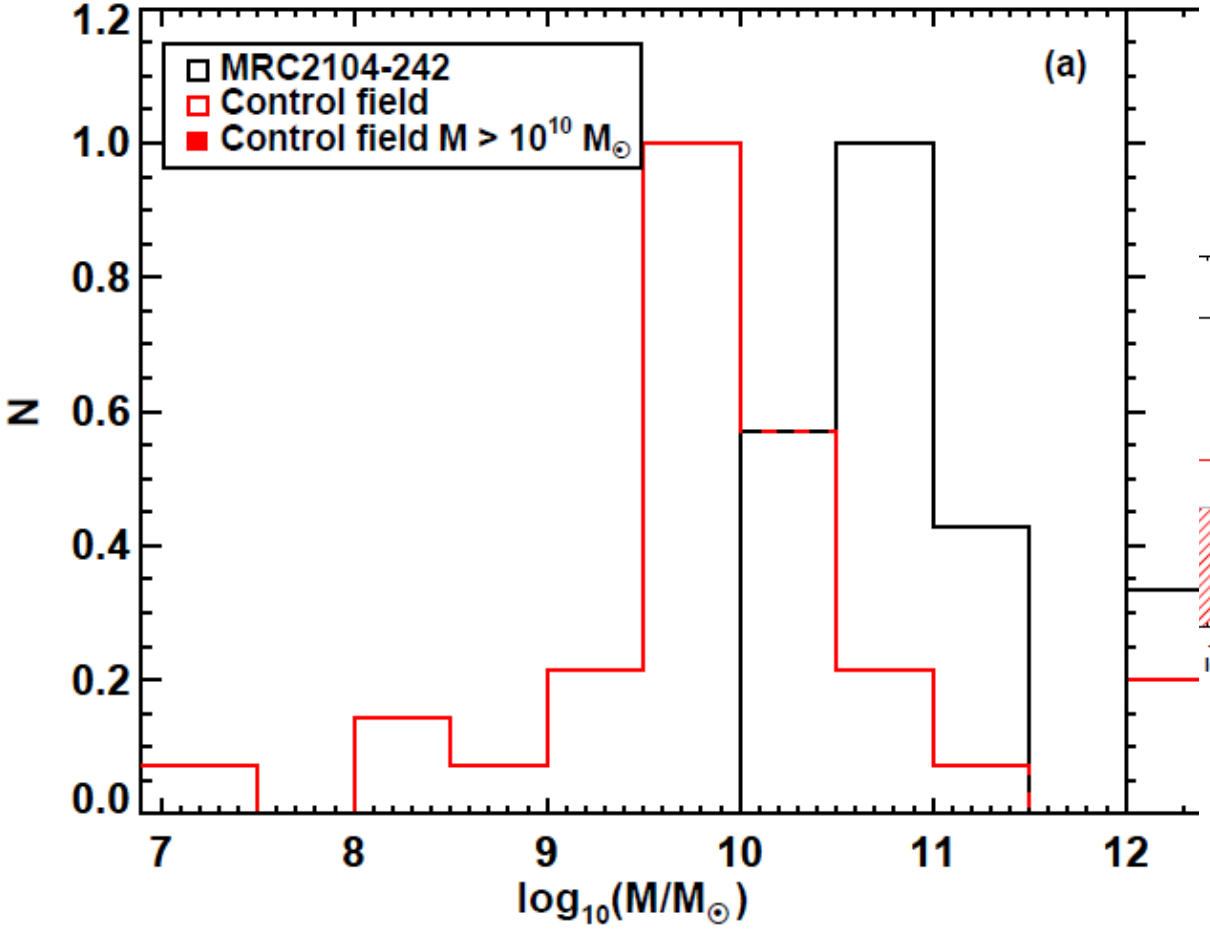
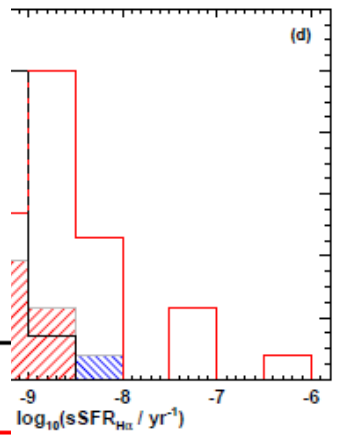
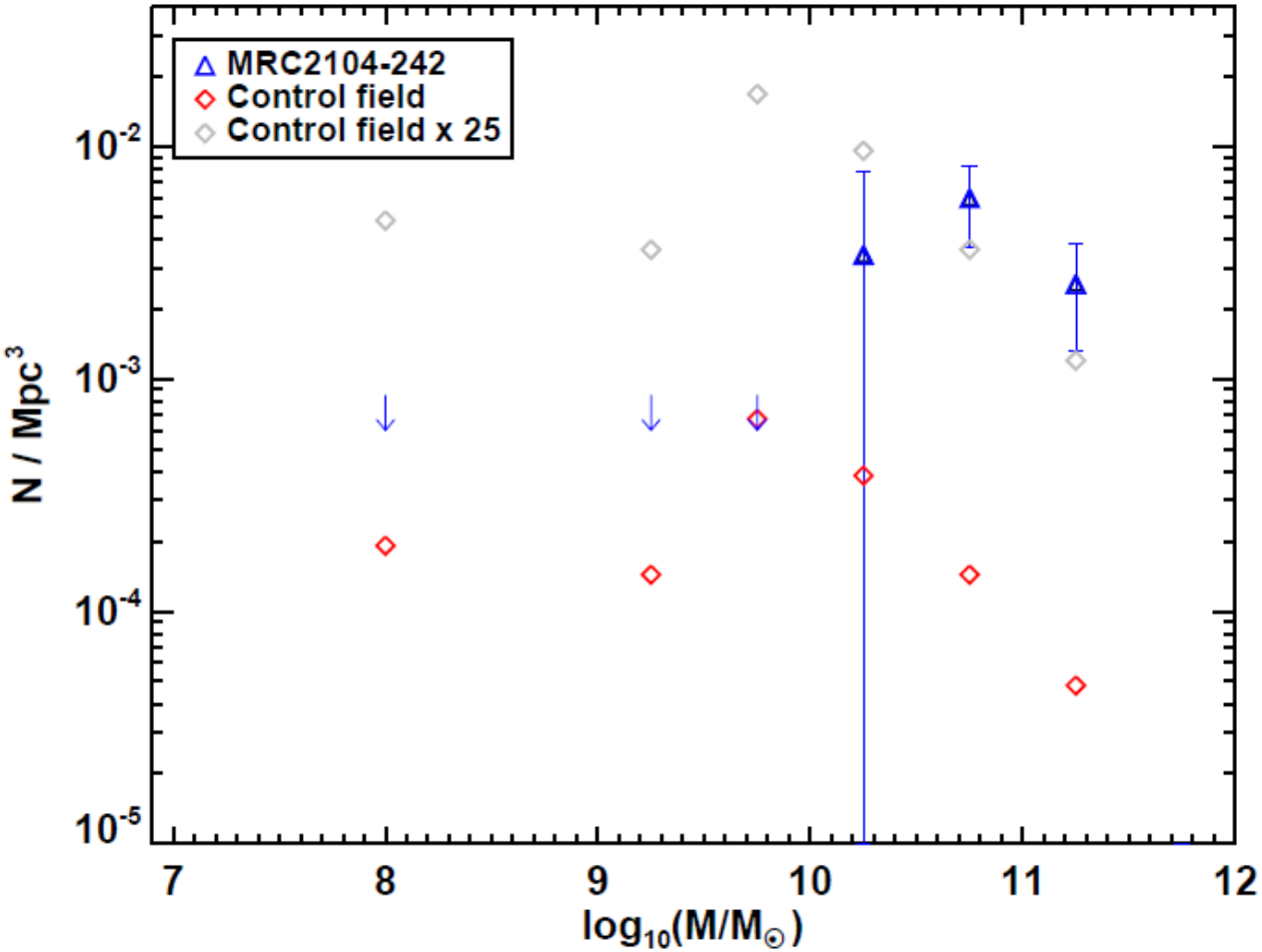






Protocluster Mass Function



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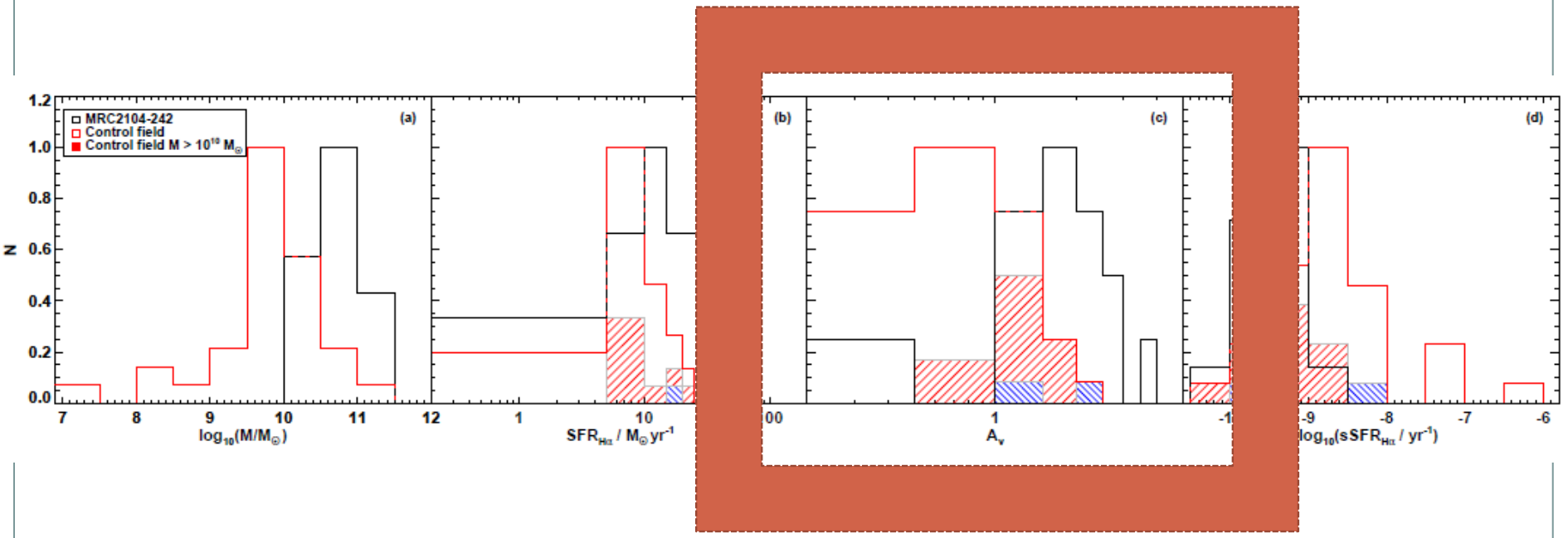
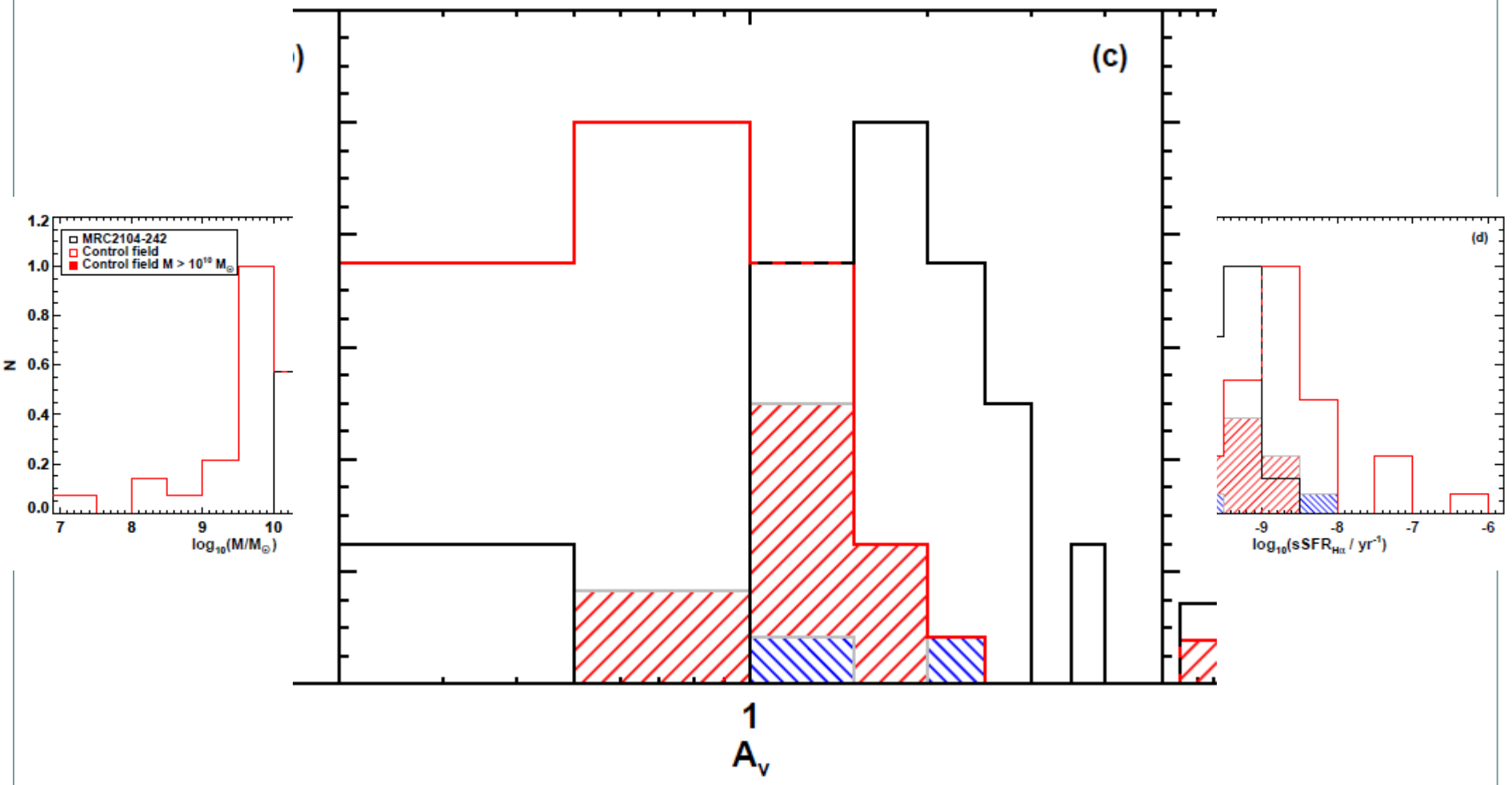
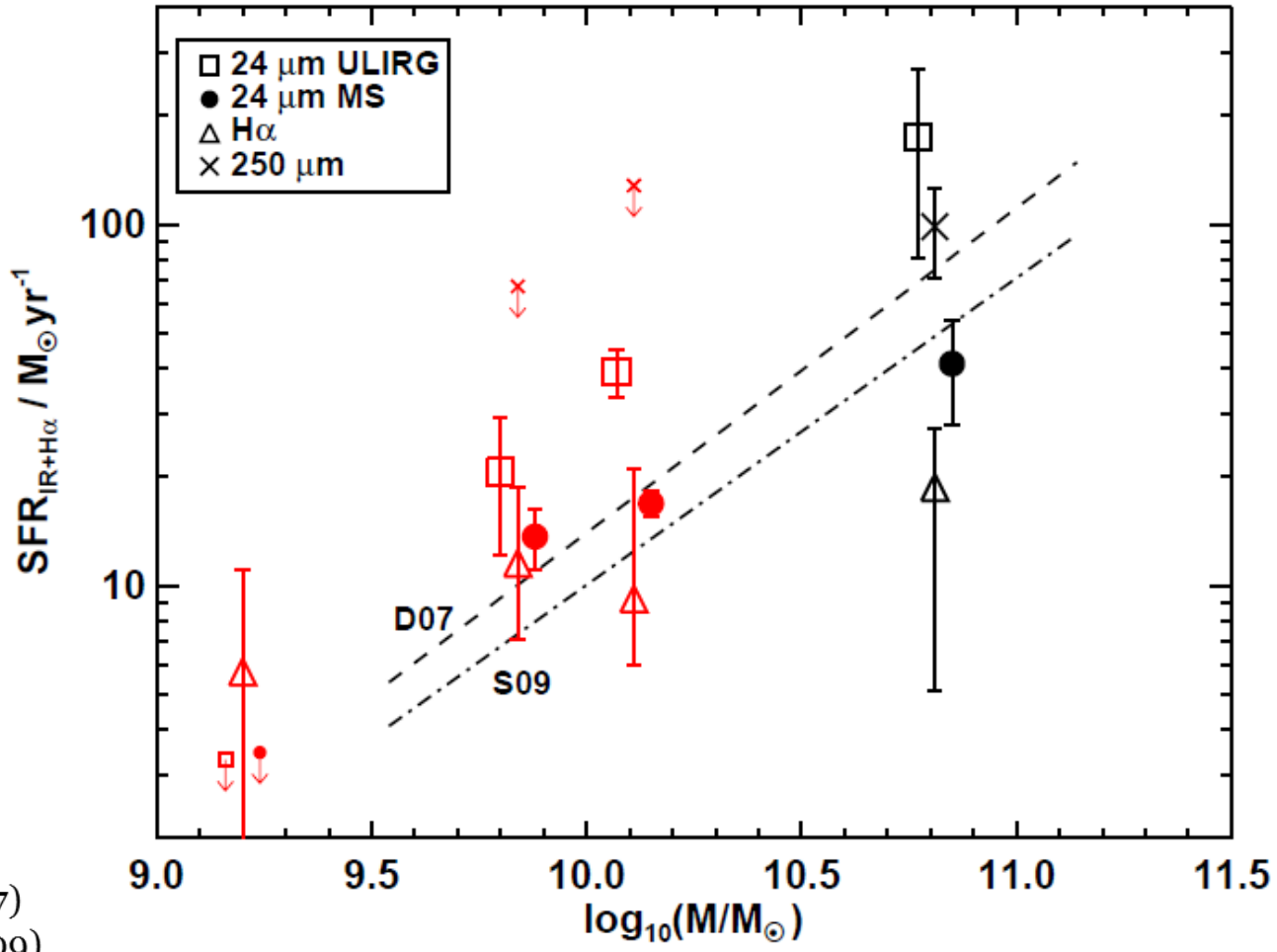


Protocluster Galaxy Properties



Star Formation Rate – Mass Relation (again)



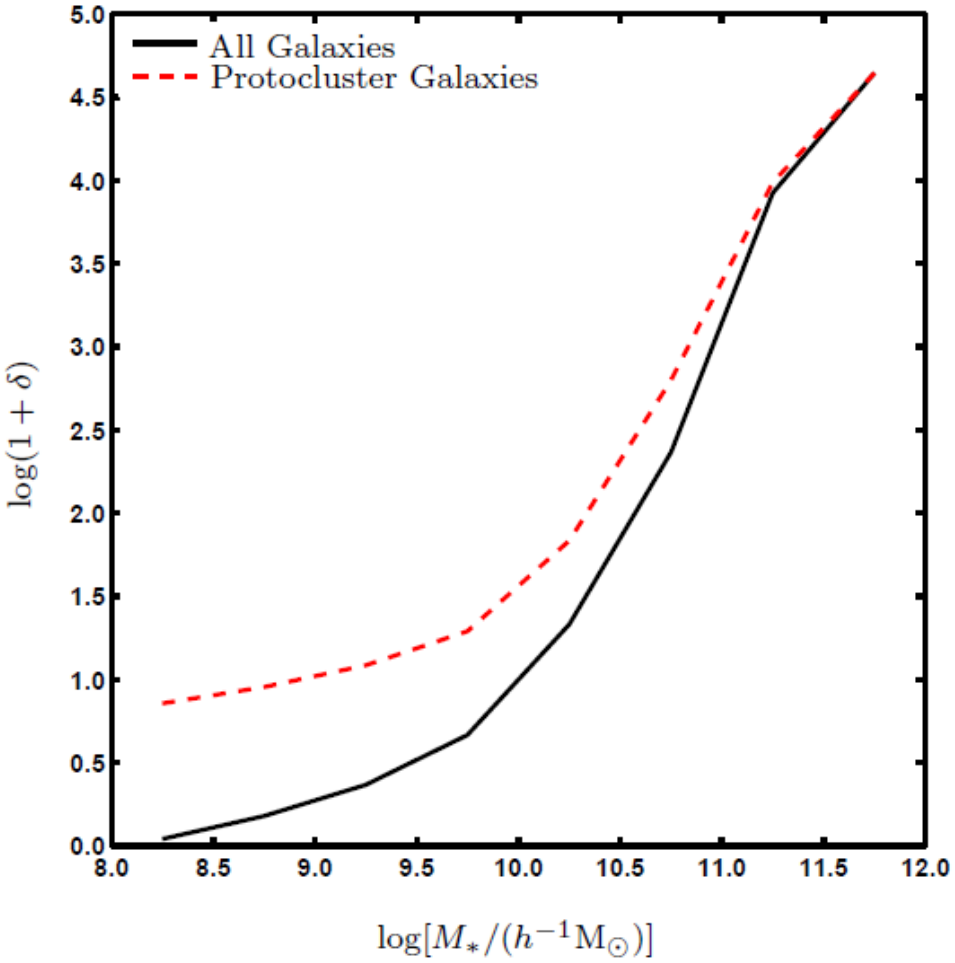
Daddi et al. (2007)
Santini et al. (2009)

What do the semi-analytics say?

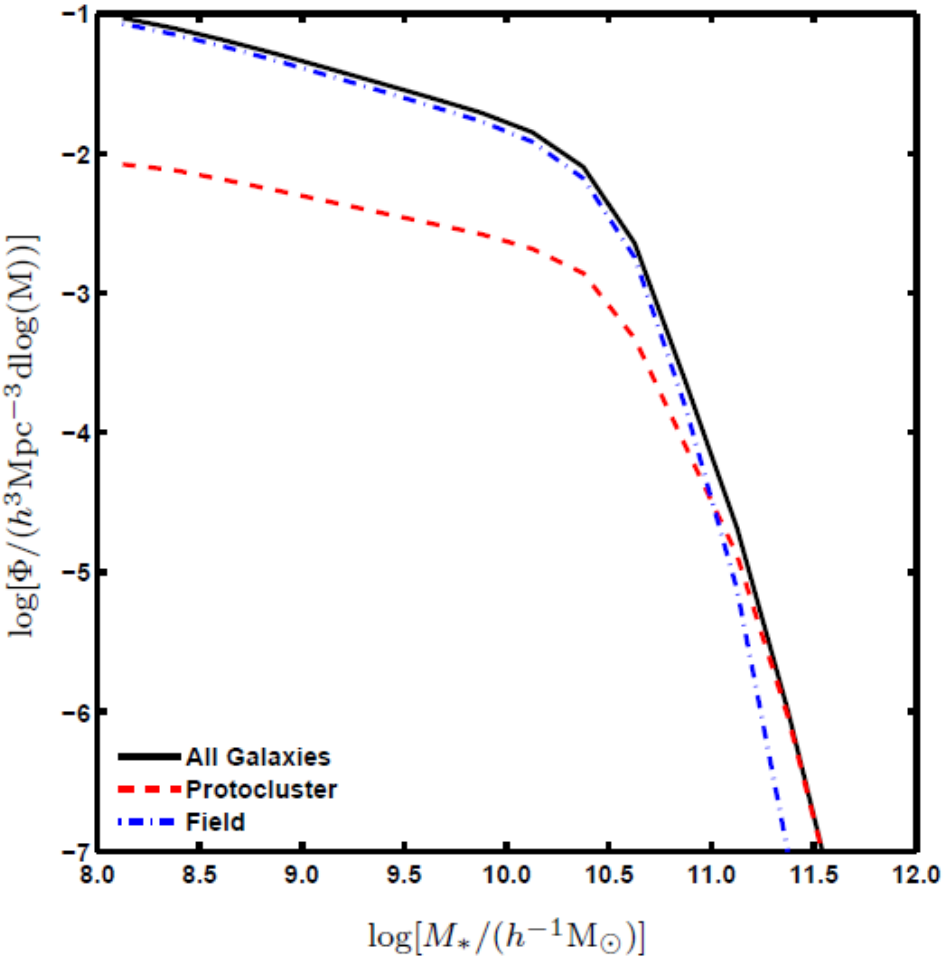
USING THE GUO ET AL. (2011) SEMI-ANALYTIC MODEL TO EXPLAIN THE OBSERVATIONS

MULDREW & HATCH (IN PREP.)

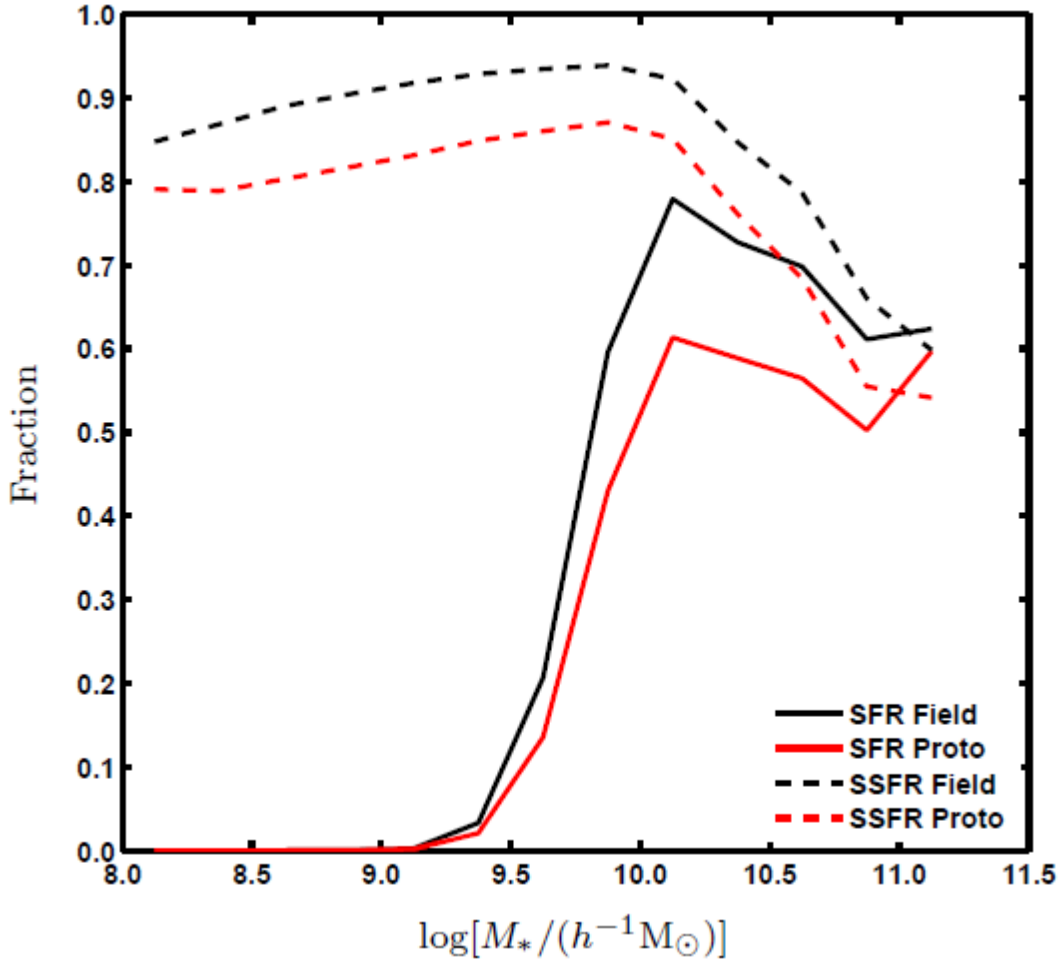
Environment



Protocluster Mass Function



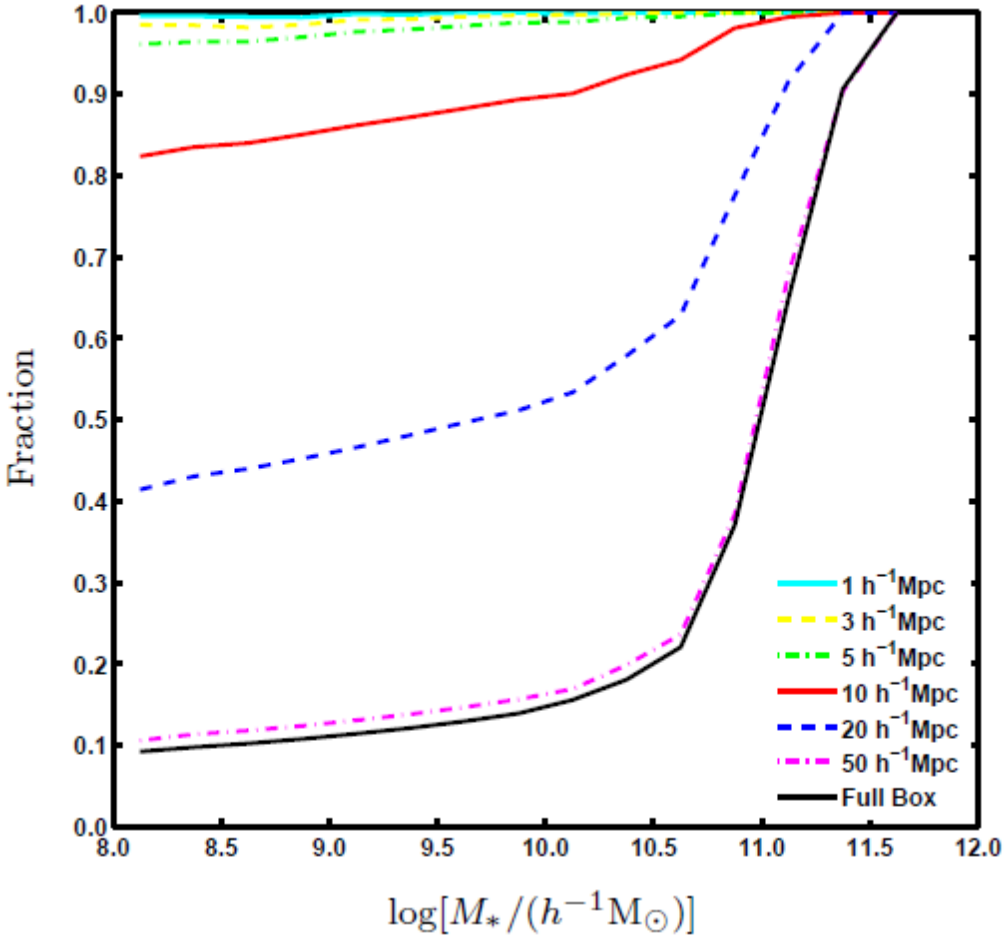
Importance of Star Forming Cut



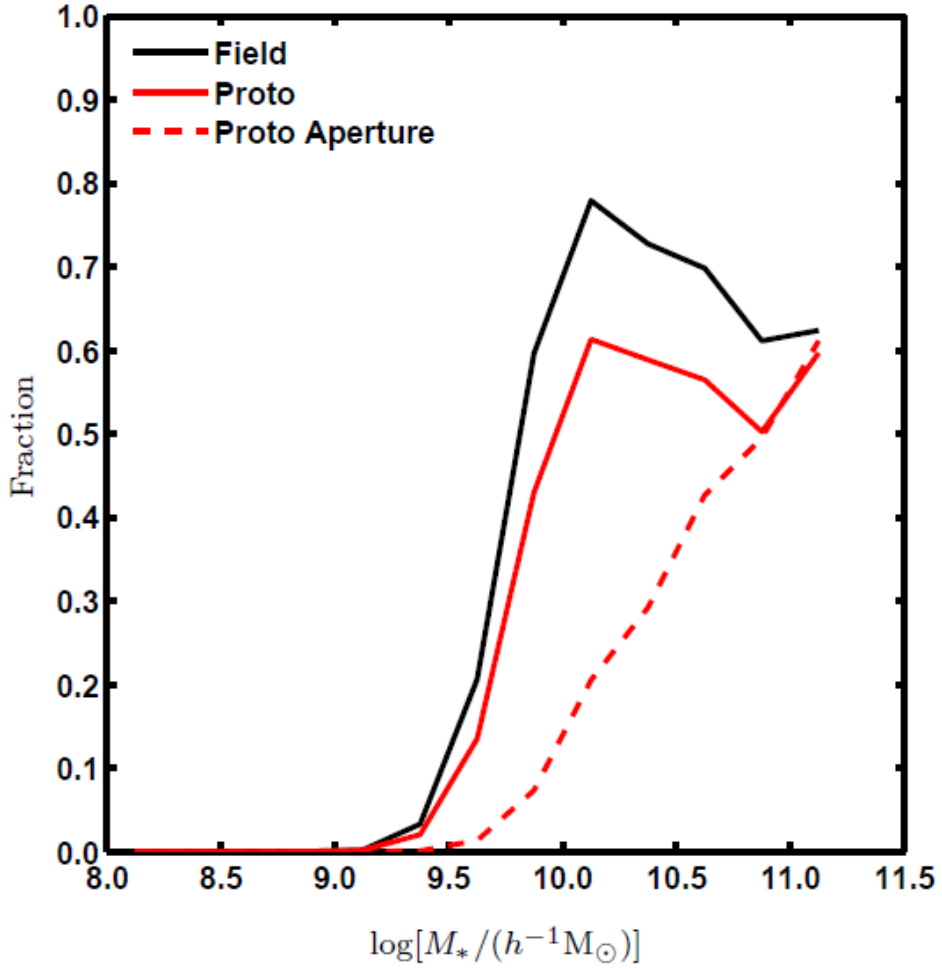
SFR: 7 $M_\odot$ yr^{-1}
Cooke et al. (sub)

SSFR: 7.43x10^{-11} yr^{-1}
Lani et al. (2013)

Protocluster Membership



Importance of Aperture Size

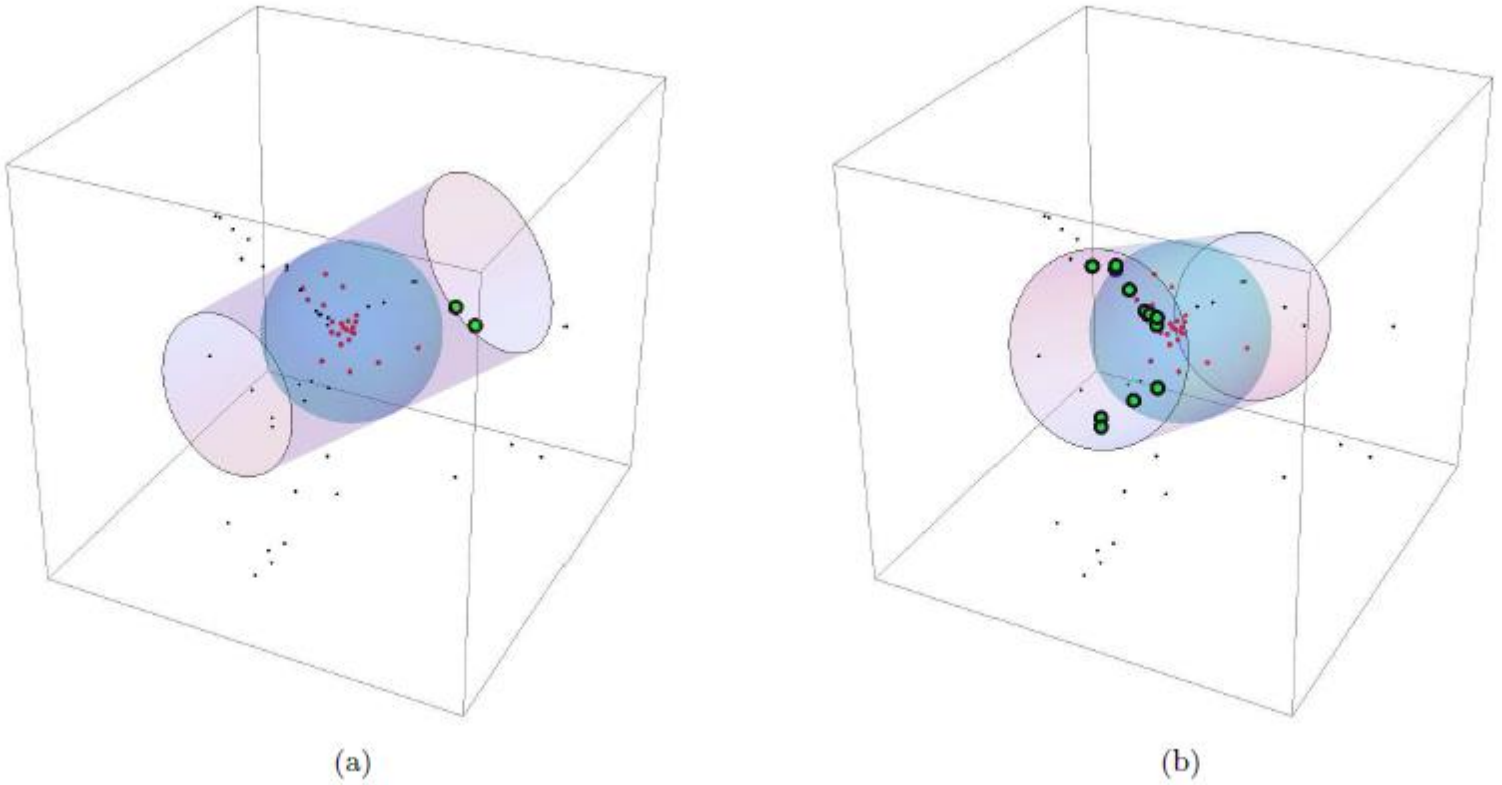


So, how overdense is an overdensity?

IF WE ARE MISSING LOW MASS GALAXIES IN THE CLUSTER THEN HOW ACCURATELY CAN WE MEASURE AN OVERDENSITY?

SHATTOW ET AL. (INC. MULDREW; 2013)
AND
MULDREW & HATCH (IN PREP.)
AND
COOKE ET AL. (INC. MULDREW; SUBMITTED)

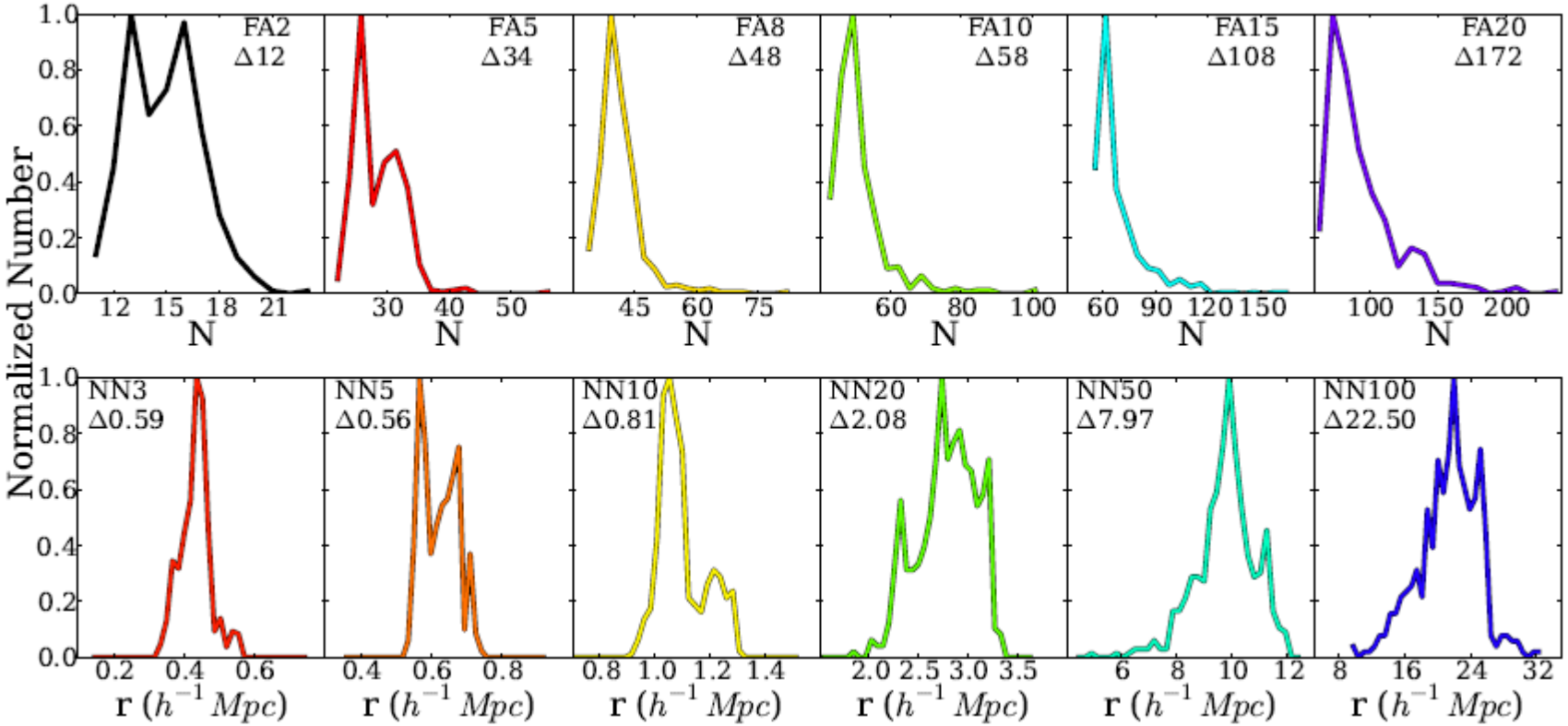
Viewing Angle



(a)

(b)

Viewing Angle



Overdensity

- The z=2.5 protocluster has an overdensity of 8.0±0.8.
- If only galaxies above $10^{10.5}$ M_0 are considered this rises to ~55.
- This has important consequences for Chiang, Overzier & Gebhardt (2013) mass predictions.

Conclusions & Future Work

WHERE DO WE GO FROM HERE?

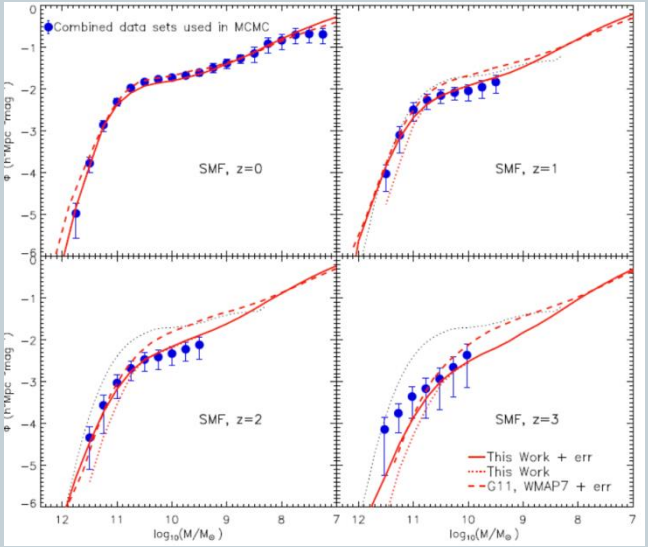
Conclusions

- Protoclusters display a lack of low mass galaxies.
- Protocluster galaxies are dustier than field and so contain hidden star formation.
- The most likely cause of the lack of low mass galaxies is a selection effect.
- Either SFR is below current detection thresholds or star formation is hidden by dust.

Future Work

- Observational protocluster sample is going to dramatically increase.

- New semi-analytic models better reproduce the high redshift Universe.



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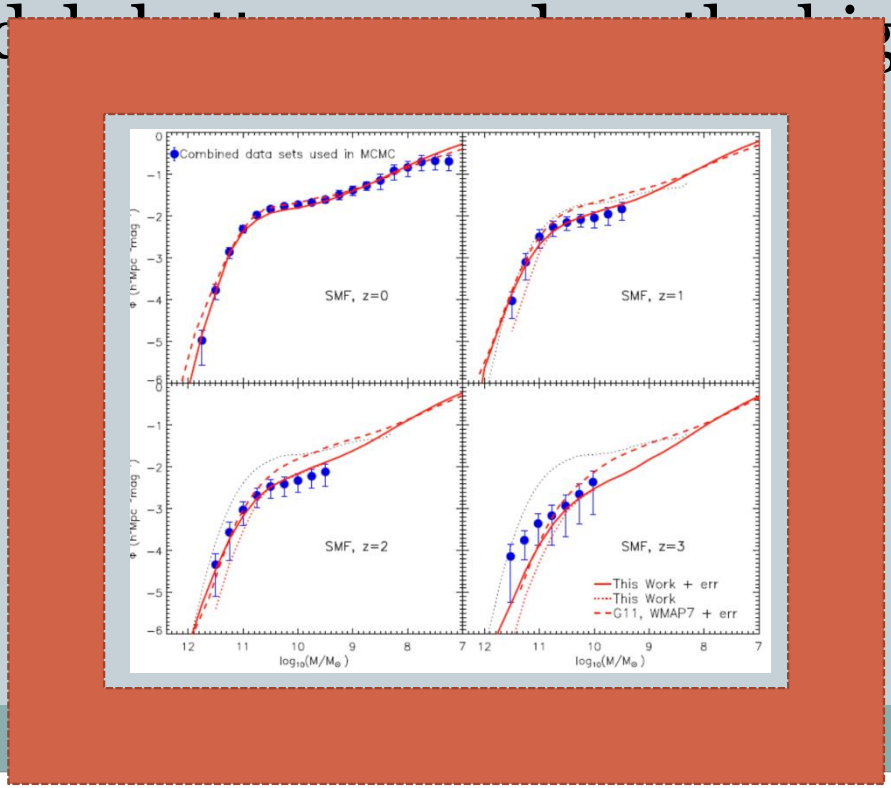
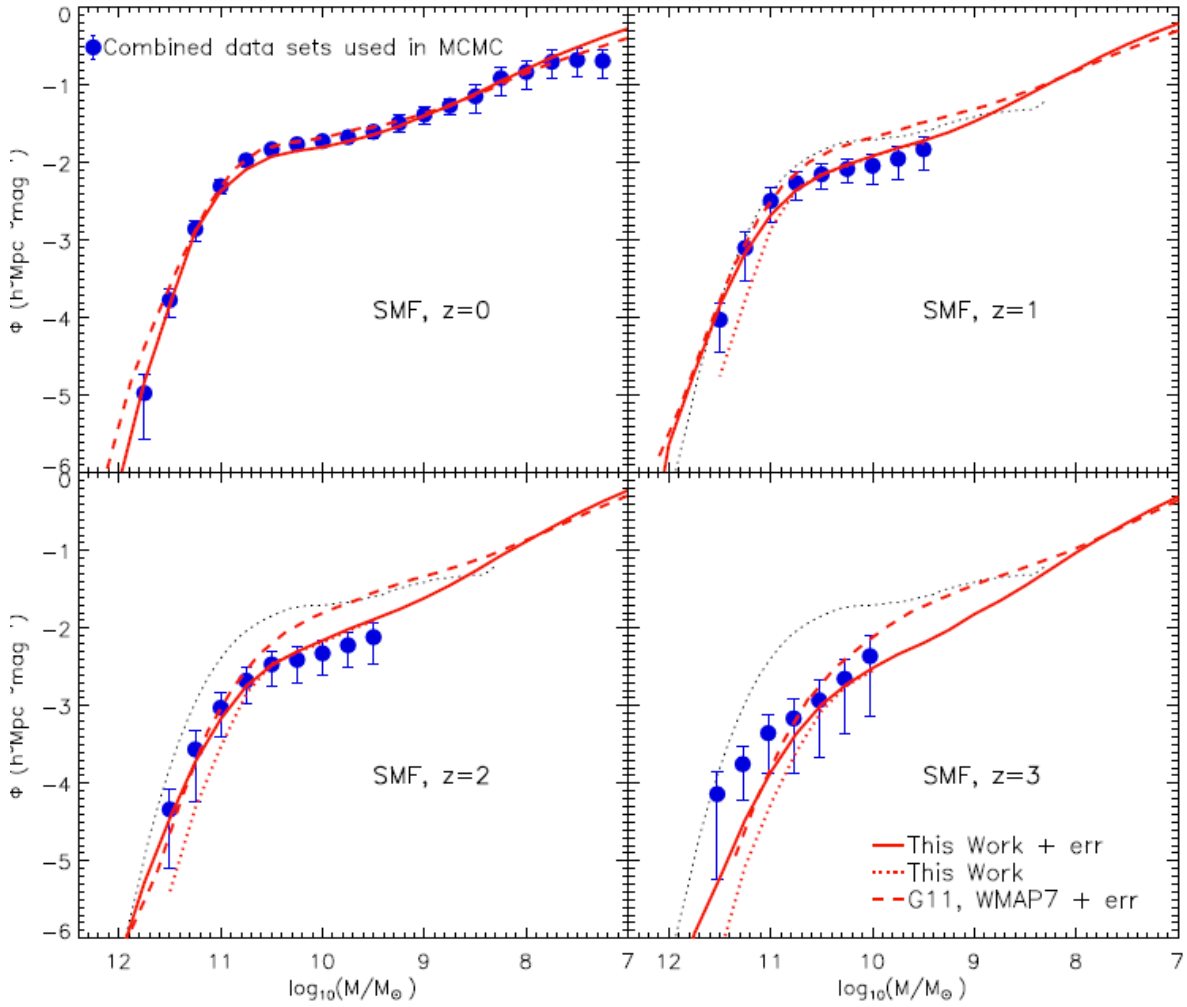


Henriques et al. (2013)



Future Work

- Observational protocluster sample is going to dramatically increase.
- New semi-analytic models better reproduce the high redshift Universe.
- New hydrodynamic models better simulate clusters.
- Now is the time to study protoclusters!

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