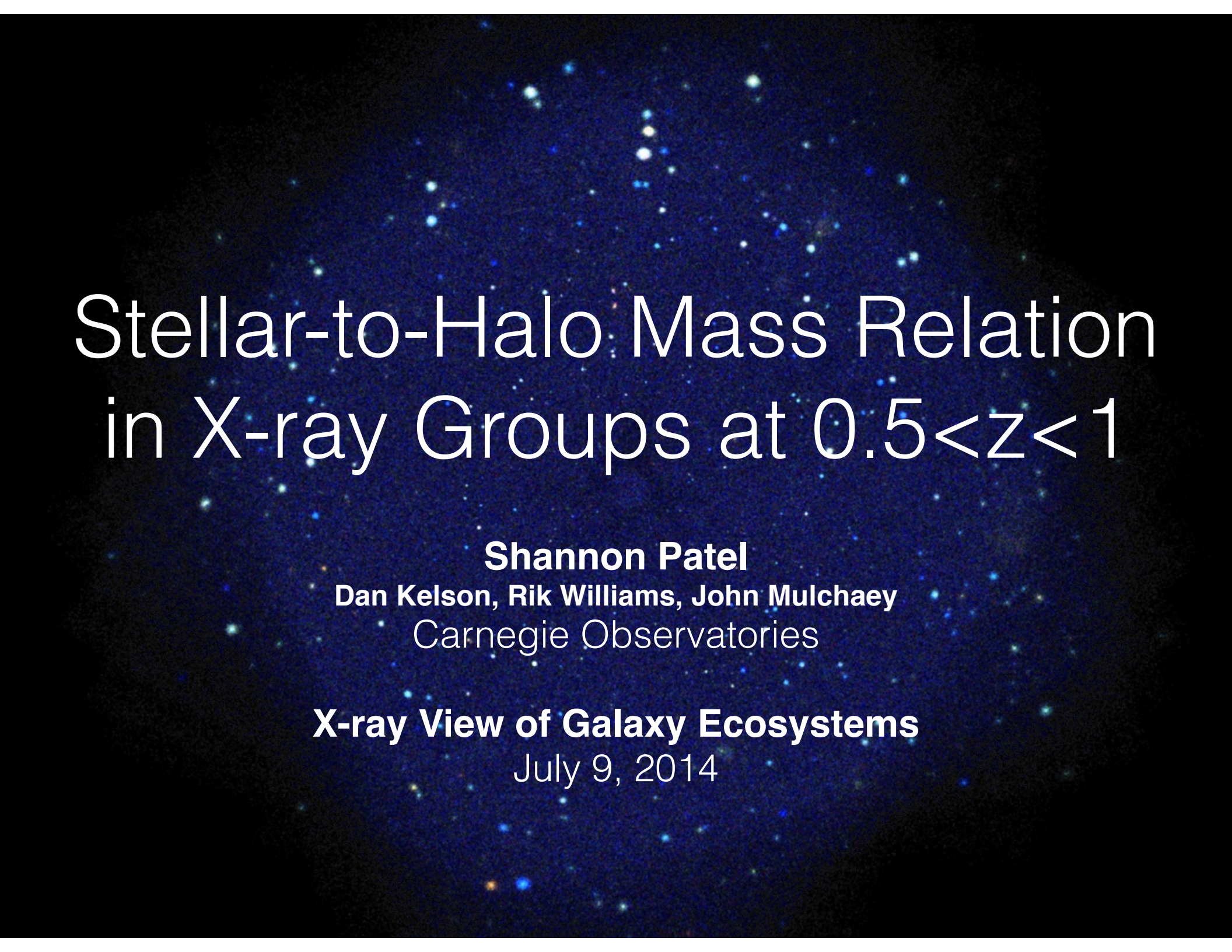

Stellar-to-Halo Mass Relation in X-ray Groups at 0.5<z<1

Shannon Patel
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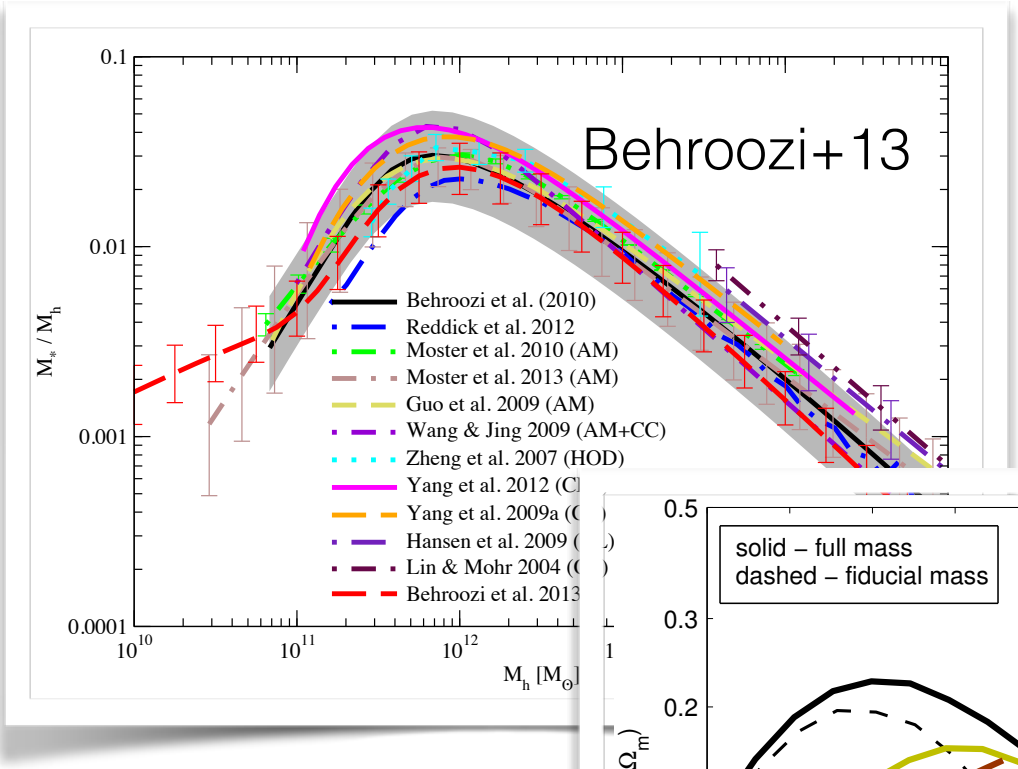
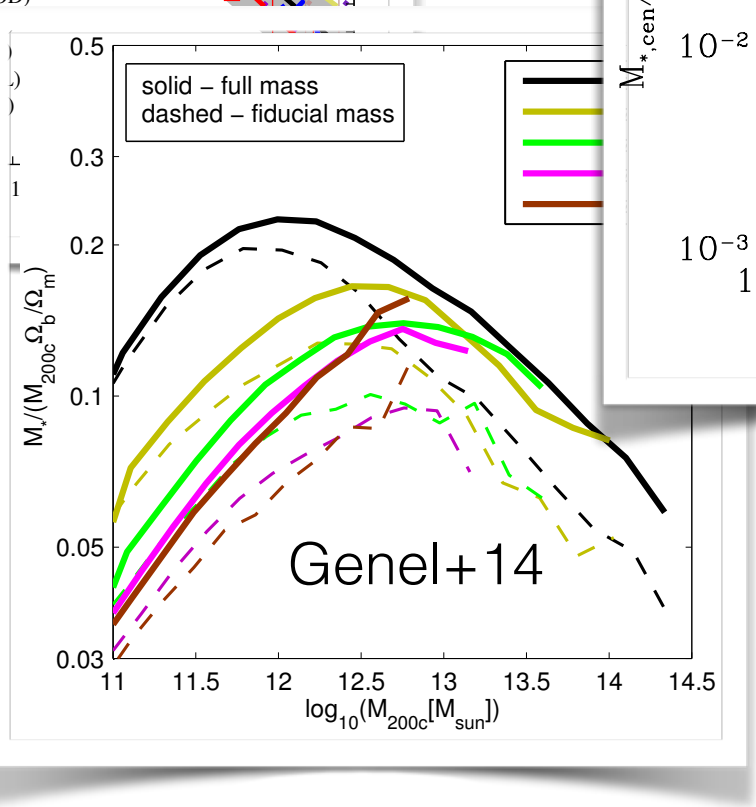
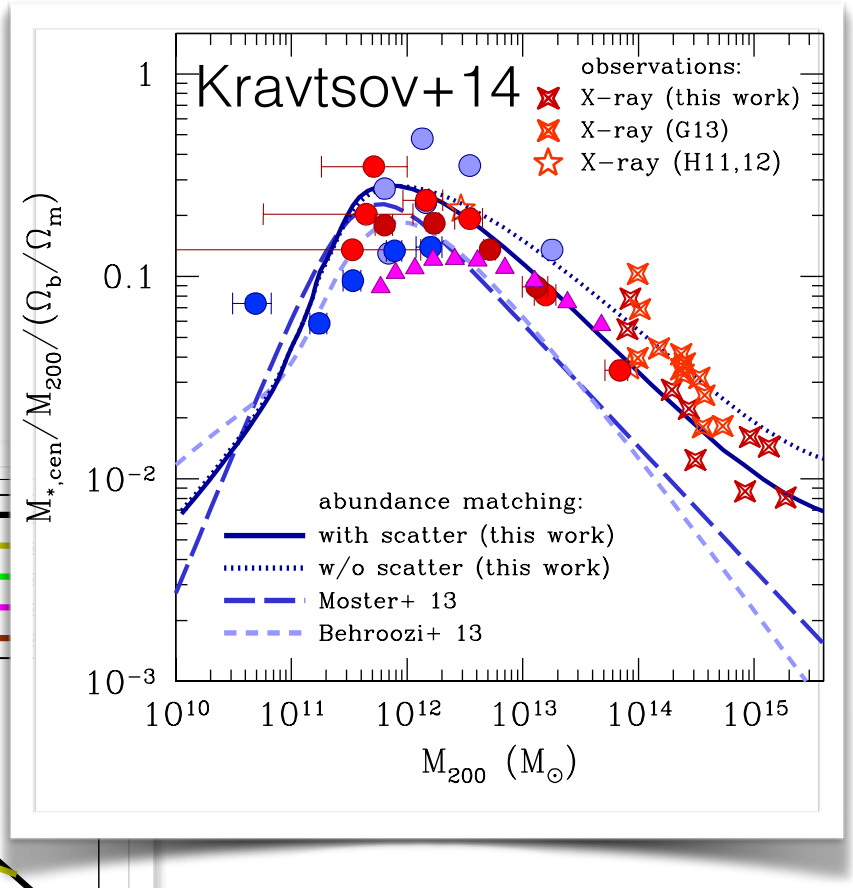
Carnegie Observatories

X-ray View of Galaxy Ecosystems
July 9, 2014

Stellar-to-halo mass relation







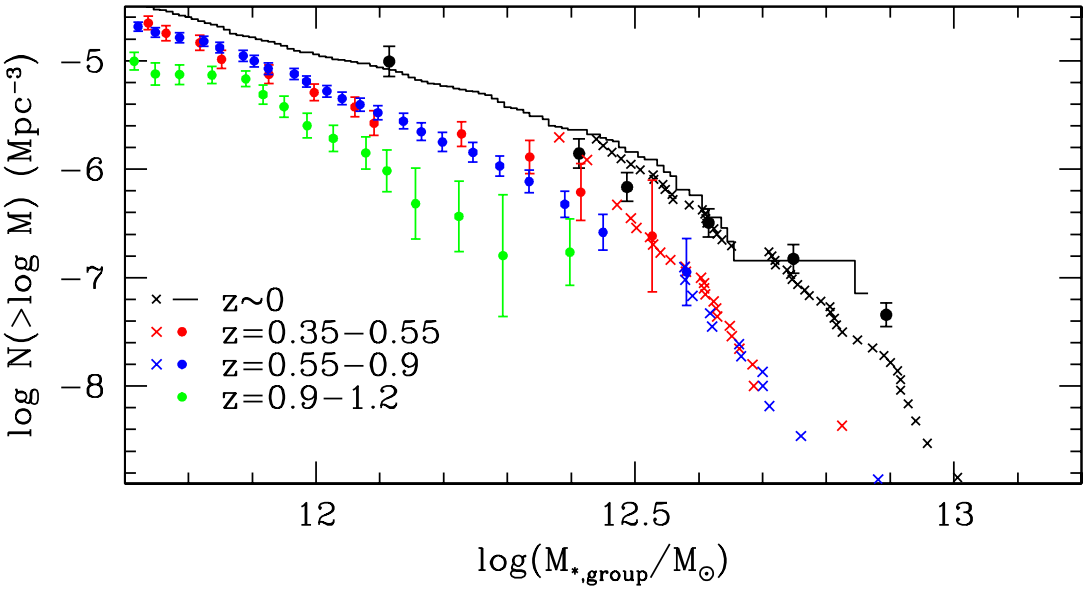
Galaxy group ecosystem is important at z<1

- Grow into clusters by z~0
  - Pre-processing/environmental quenching, etc.

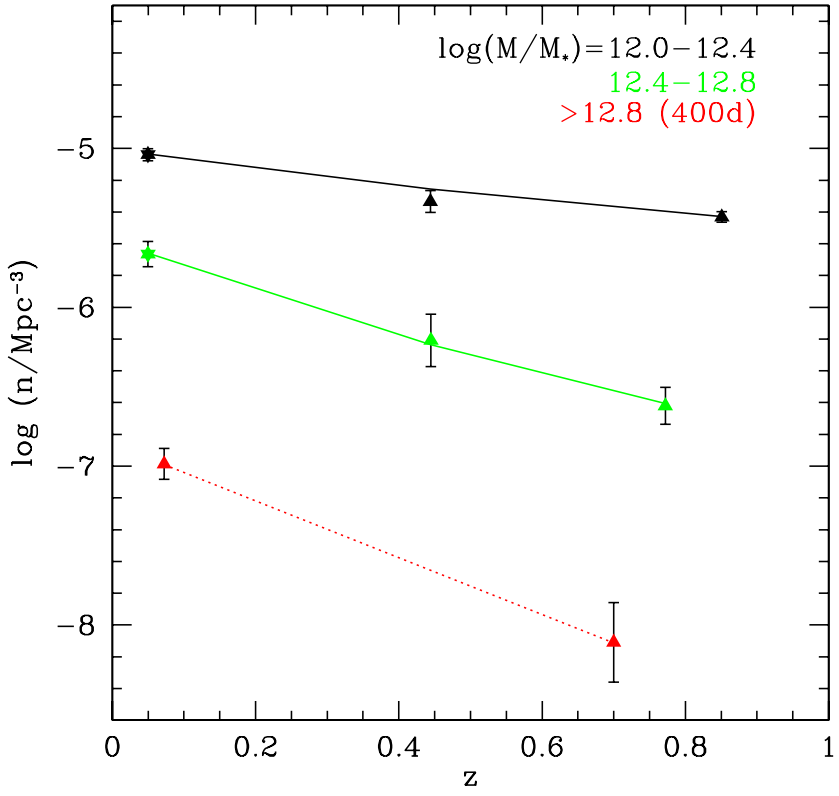
- Hierarchical growth at z<1 leads to a dramatic increase in their number density

Rise of groups at z<1 in the Carnegie-Spitzer-IMACS (CSI) survey

cumulative number density



total group stellar mass



redshift

Williams+12b

Galaxy group ecosystem is important at z<1

- Grow into clusters by z~0
  - Pre-processing/environmental quenching, etc.
- Hierarchical growth at z<1 leads to a dramatic increase in their number density
- **What is the efficiency of forming/assembling stars in such halos at these redshifts?**
  - **Current measurements are sparse in this mass/redshift regime**

Sample selection

- **Groups**
  - 20 X-ray groups at 0.5<z<1 from Chandra Deep Field South (CDFS) catalog of Finoguenov et al. 2014
    - Deepest X-ray dataset to date (Chandra + XMM-Newton)
    - *X-ray view is important as it allows reliable detection of groups at high redshift*

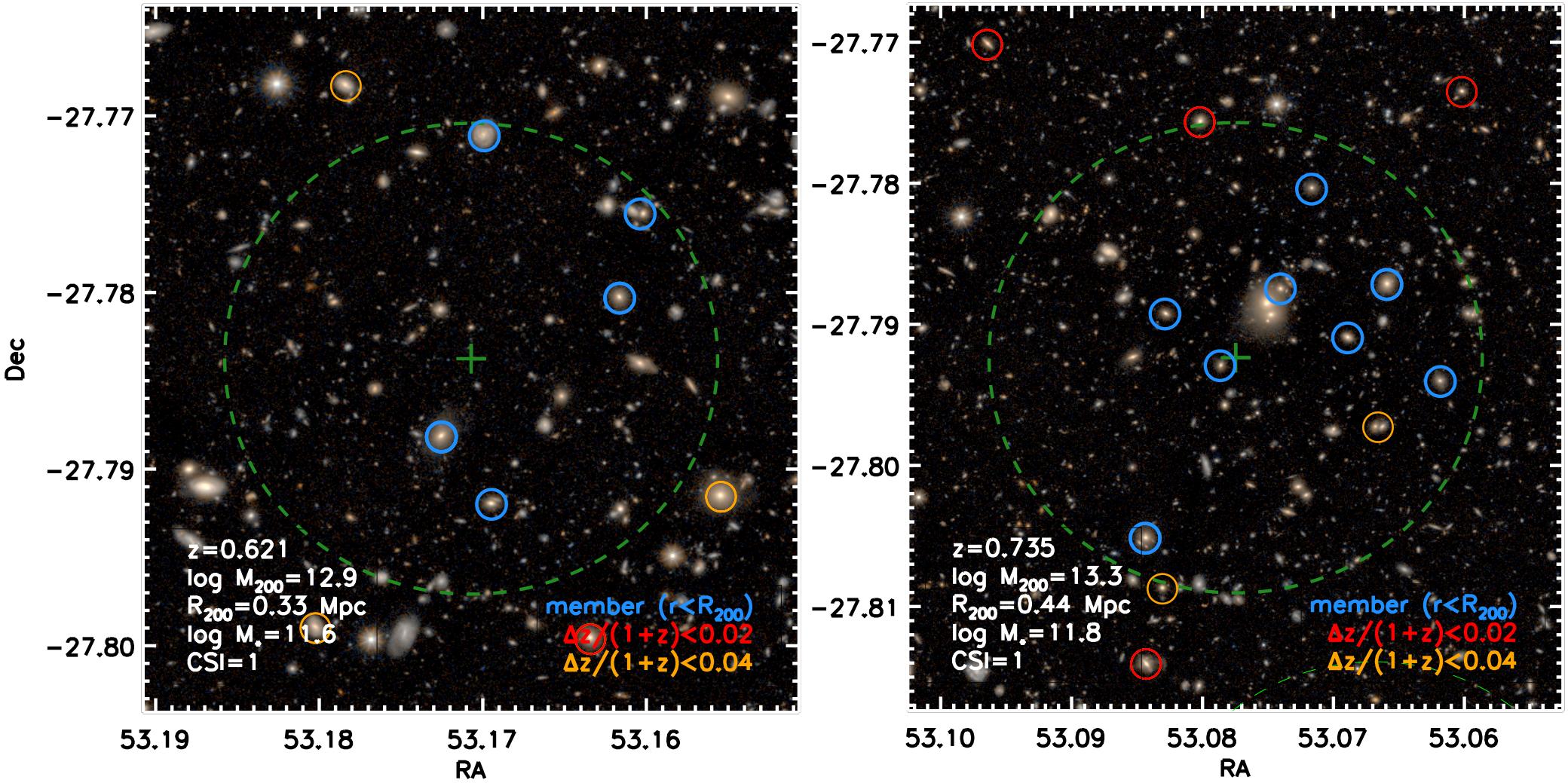
- **Galaxies**
  - Carnegie-Spitzer-IMACS (CSI) survey (Kelson et al. 2014)
  - Low resolution spectroscopic survey covering ~15 sq. deg: $\sigma_z/(1+z)\sim0.008$ for sample used here
  - IRAC 3.6-μm selected: low stellar mass limit
  - Uniform survey, completeness well understood and mapped in magnitude, color, and spatial position

Mass measurements

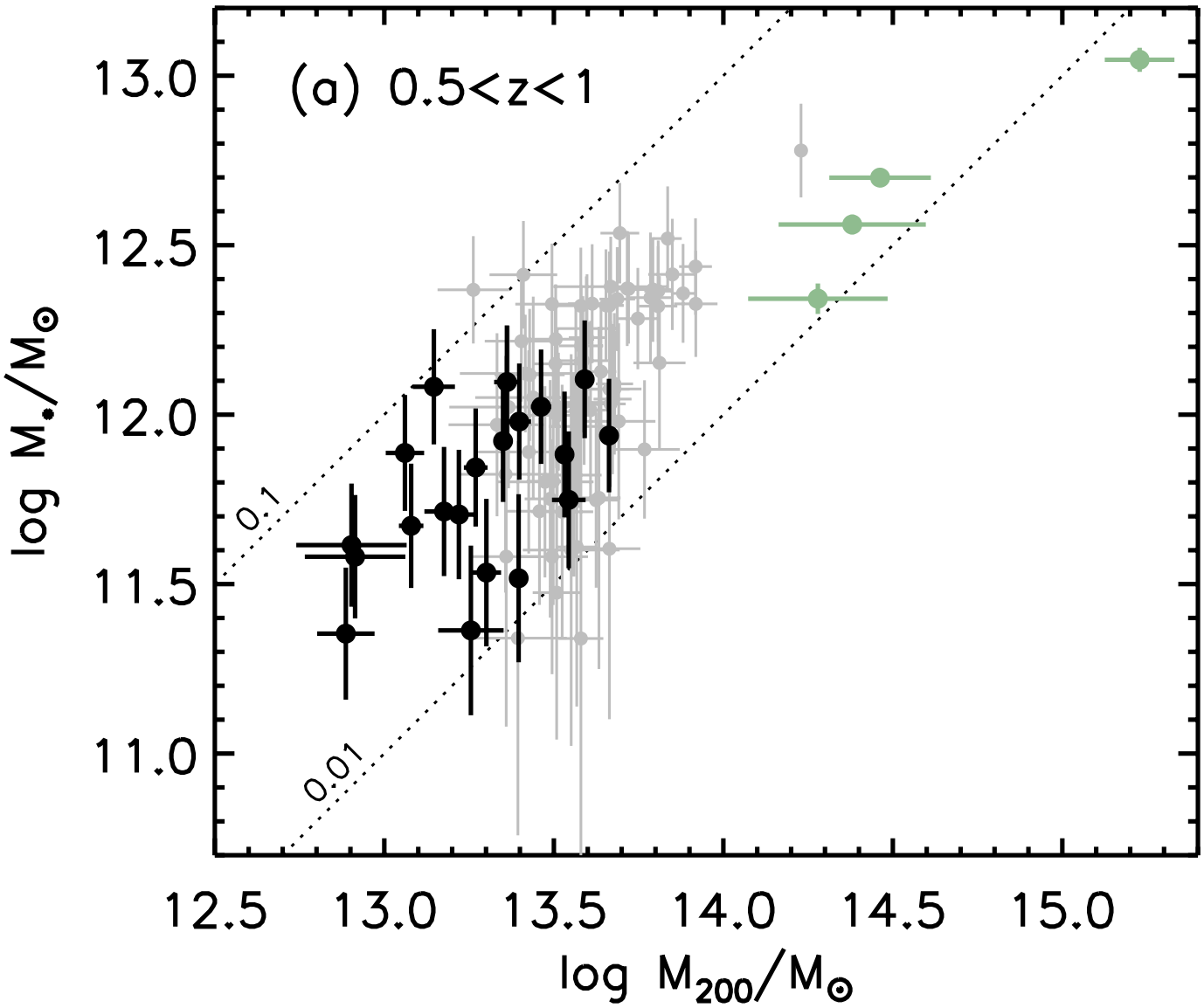
- **Total halo mass, M_{200}**
  - From Finoguenov+2014: weak lensing L_X-M_{200} calibration of Leauthaud+2010 in COSMOS at similar redshifts

- **<u>Total</u> group stellar mass, $M_\star$**
  - Mass within $R<R_{200}$ at $\Delta z/(1+z)<0.02$ (e.g., similar to Giodini+09)
    - Subtract off average background contribution measured from apertures across the field
  - Corrections for spectroscopic completeness, stellar mass limit of survey, etc.
  - Error analysis takes all of this into account

Example groups in CDFS



$M_\star$-M_{200} relation at 0.5<z<1



Samples:

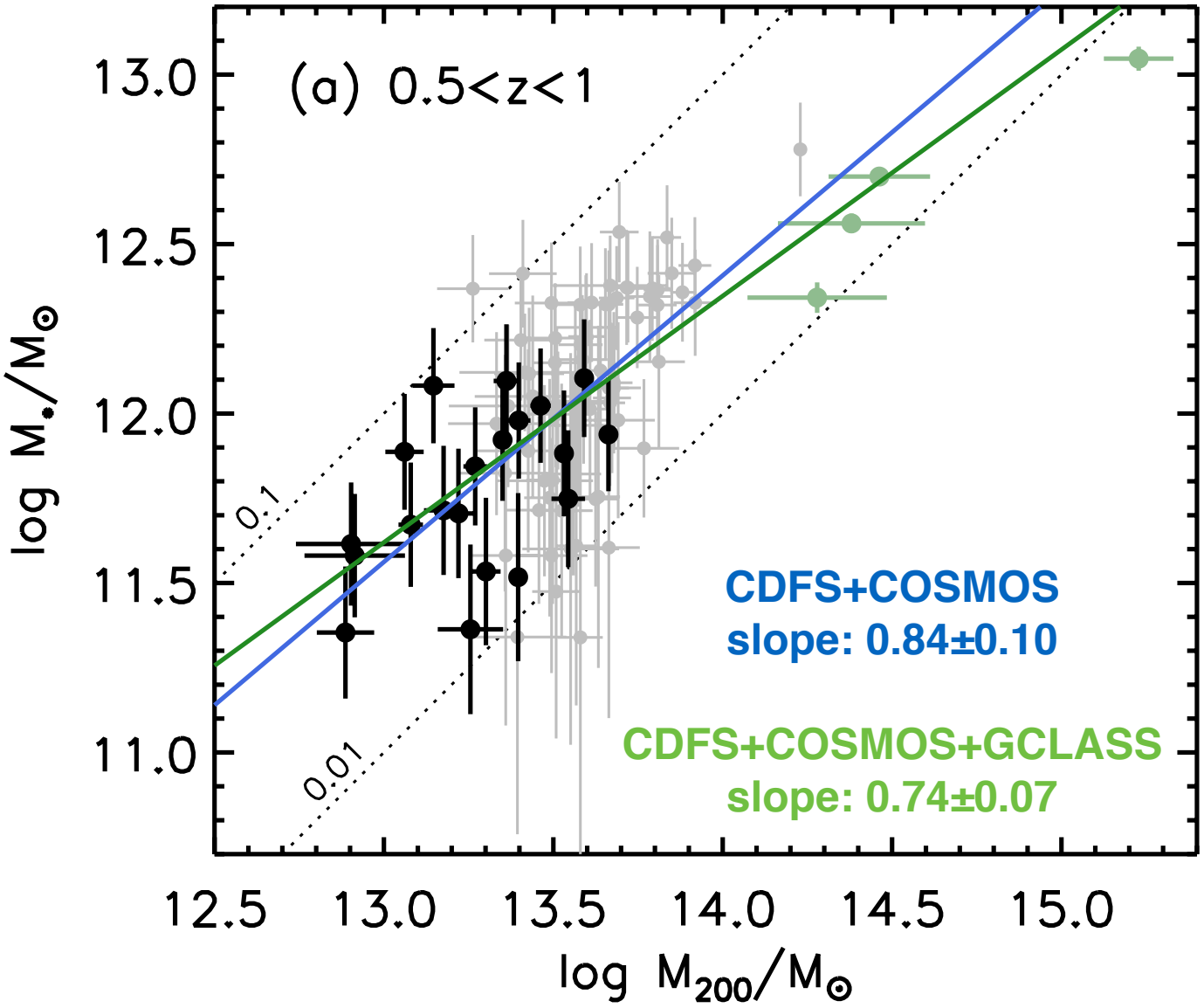
CDFS(20) - this work

COSMOS(69) - George+11

GCLASS(4) -van der Burg+14

CDFS sample extends relation to low group masses: $M_\star/M_{200}$~3%

$M_\star$-M_{200} relation at 0.5<z<1: ***slope***



Samples:

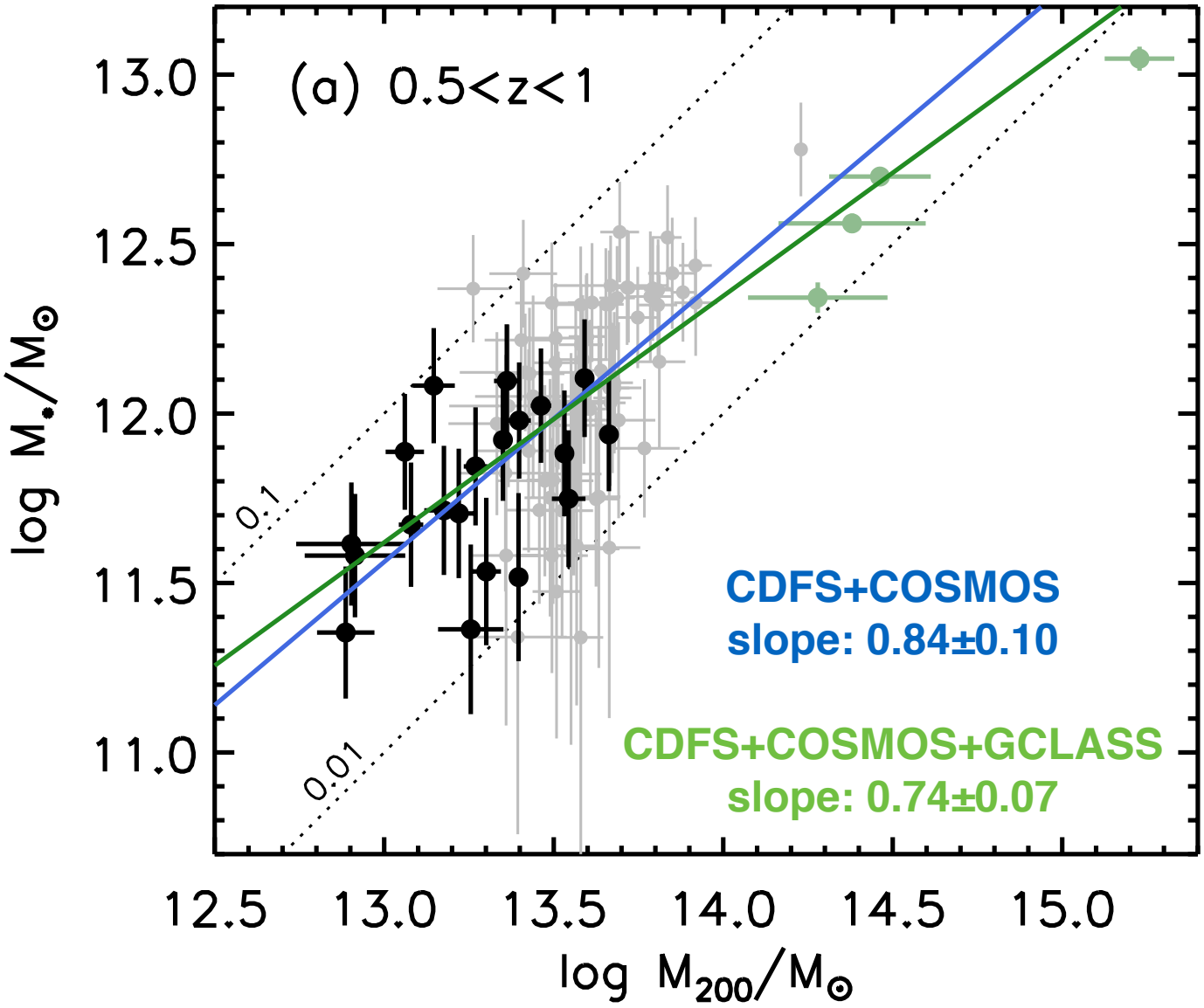
CDFS(20) - this work

COSMOS(69) - George+11

GCLASS(4) -van der Burg+14

Slope less than unity: $M_\star/M_{200}$ decreases in more massive halos

$M_\star$-M_{200} relation at 0.5<z<1: ***scatter***



Samples:

CDFS(20) - this work

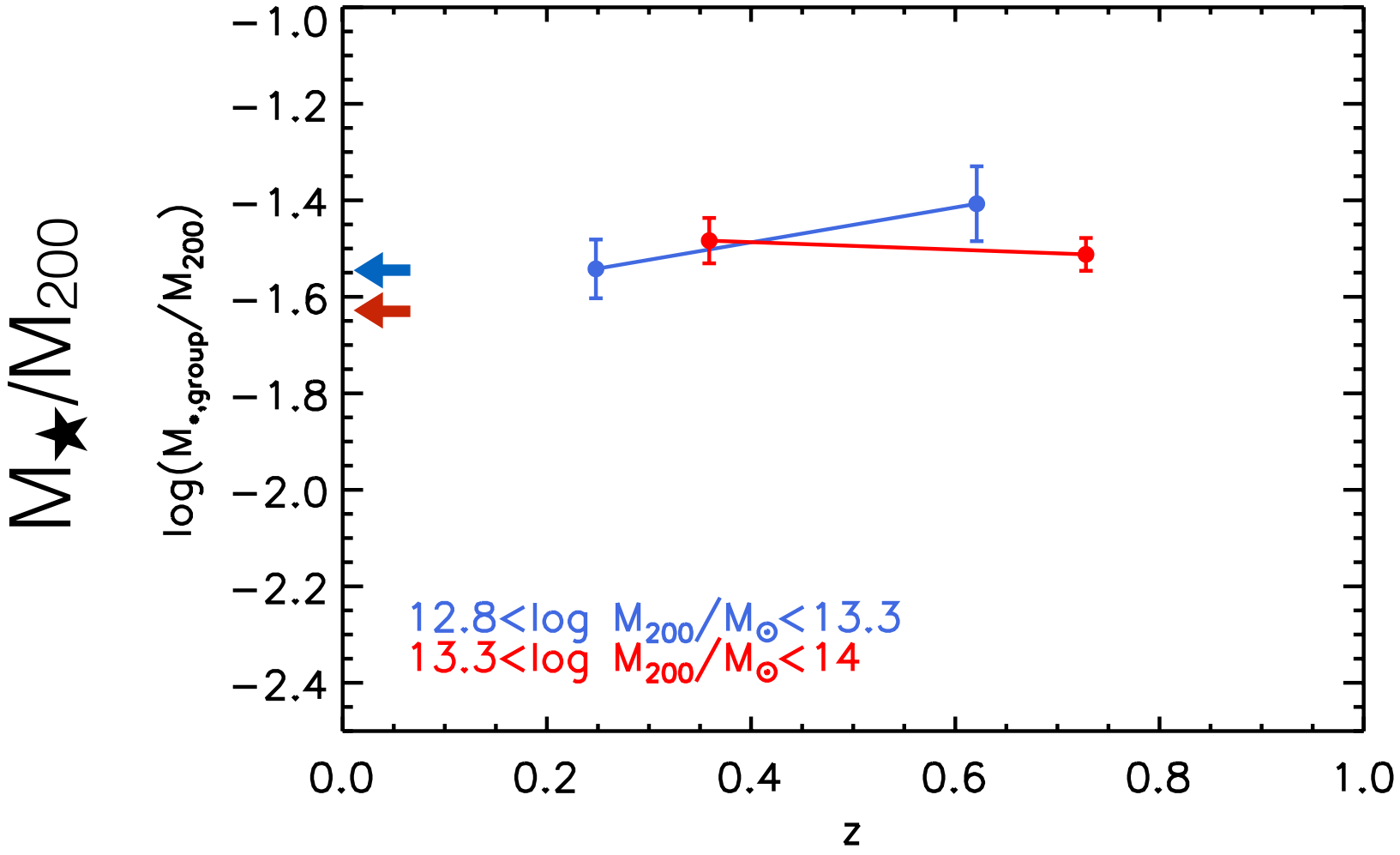
COSMOS(69) - George+11

GCLASS(4) -van der Burg+14

Observed scatter: σ=0.25 dex

→ Use $M_\star$ as a proxy for M_{200}

No strong evolution in $M_\star/M_{200}$ in the group regime



Arrows:
z~0 from Kravtsov+14
(abundance matching)

Summary

- **Group ecosystem plays an important role in galaxy evolution at z<1**
  - Significant growth in number density of groups at z<1 (Williams+12b)
  - CSI galaxies + ***X-ray detected groups*** in CDFS probe efficiency of forming/ assembling stars in such halos
- **Stellar-to-halo mass in low mass X-ray groups at 0.5<z<1:**
  - At M_{200}~2x10^{13} $M_{\odot}$(i.e., previously unexplored territory): $M_{\bigstar}/M_{200}$~3%
  - Small scatter (~0.25 dex): stellar mass a good proxy for halo mass ➔ calibration for CSI survey group catalog
  - Decreasing trend with higher mass when including samples over a larger mass range
- **No strong evolution in the stellar-to-halo mass ratio in the group regime since z~1**
- **Paper on the arXiv soon!**