HALO ASSEMBLY BIAS AND SPLASHBACK RADIUS ON CLUSTER SCALES

STATUS OF MY UNDERSTANDING OF OBSERVATIONAL RESULTS

~~OBSERVATIONAL STATUS~~

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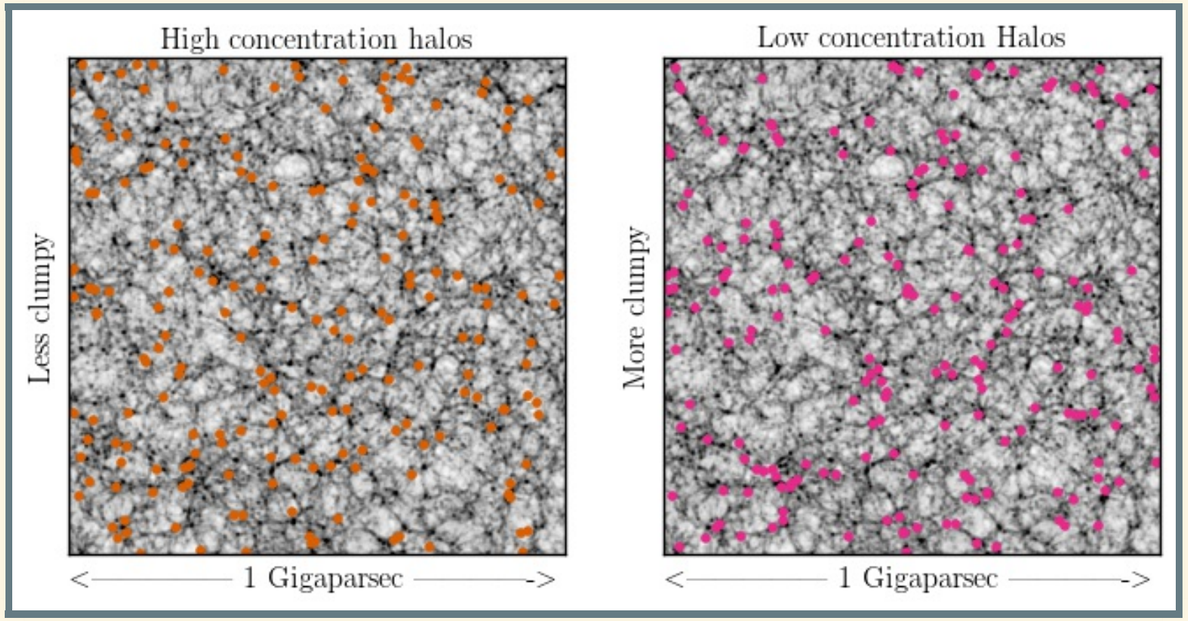
HALO ASSEMBLY BIAS - IN SIMULATIONS



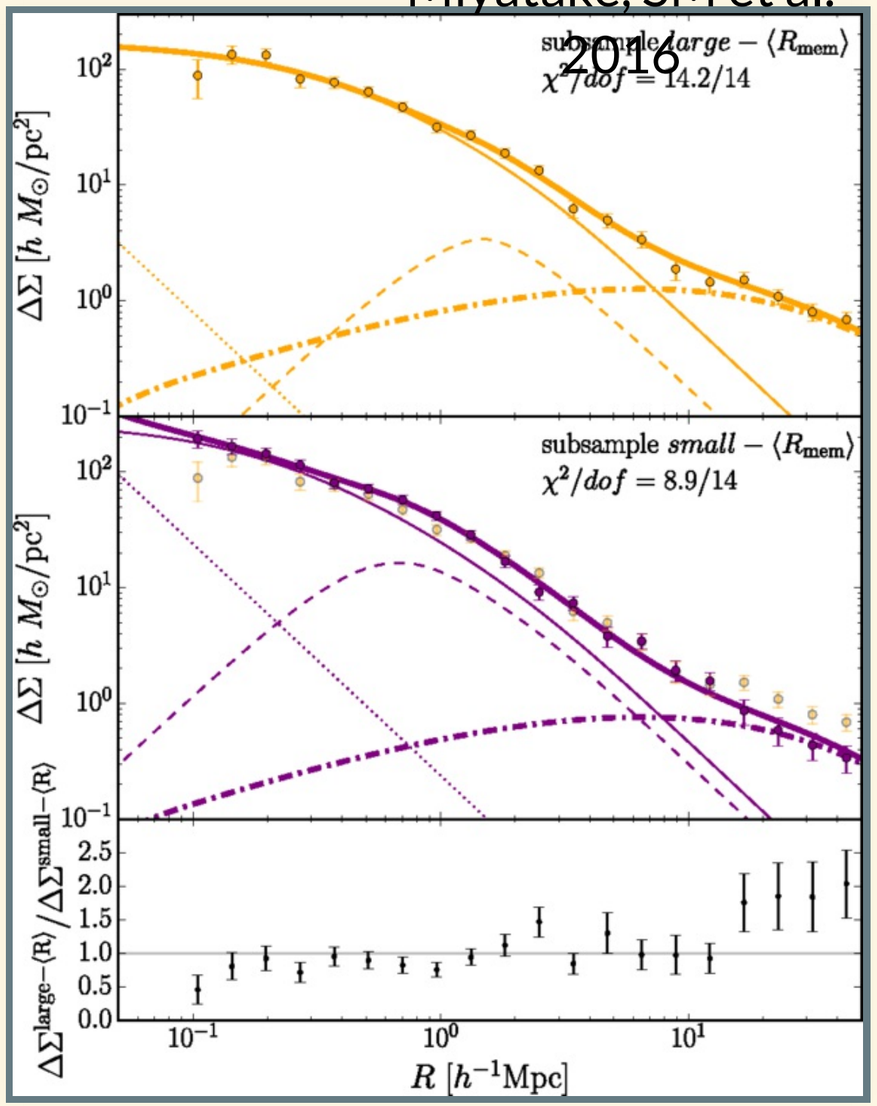
- Dependence of the large scale clustering amplitude on secondary parameters other than the halo mass (see Gao et al. 2005, 2008, Wechsler et al. 2006)
- If galaxy properties correlate with these secondary properties, then clustering amplitude cannot determine mass in an unbiased manner.

HALO ASSEMBLY BIAS - IN OBSERVATIONS

- Optical cluster catalog - SDSS Redmapper (Rykoff et al. 2014)
  - The range: $z \in [0.1, 0.33]$
  - 8648 clusters in total
  - Cluster scales reduce the problem of satellite contamination
- Divide into two based on the average cluster-centric distance of member galaxies
  - Easy to measure compared to dark matter halo concentration
- Control for halo mass using the weak gravitational lensing signal

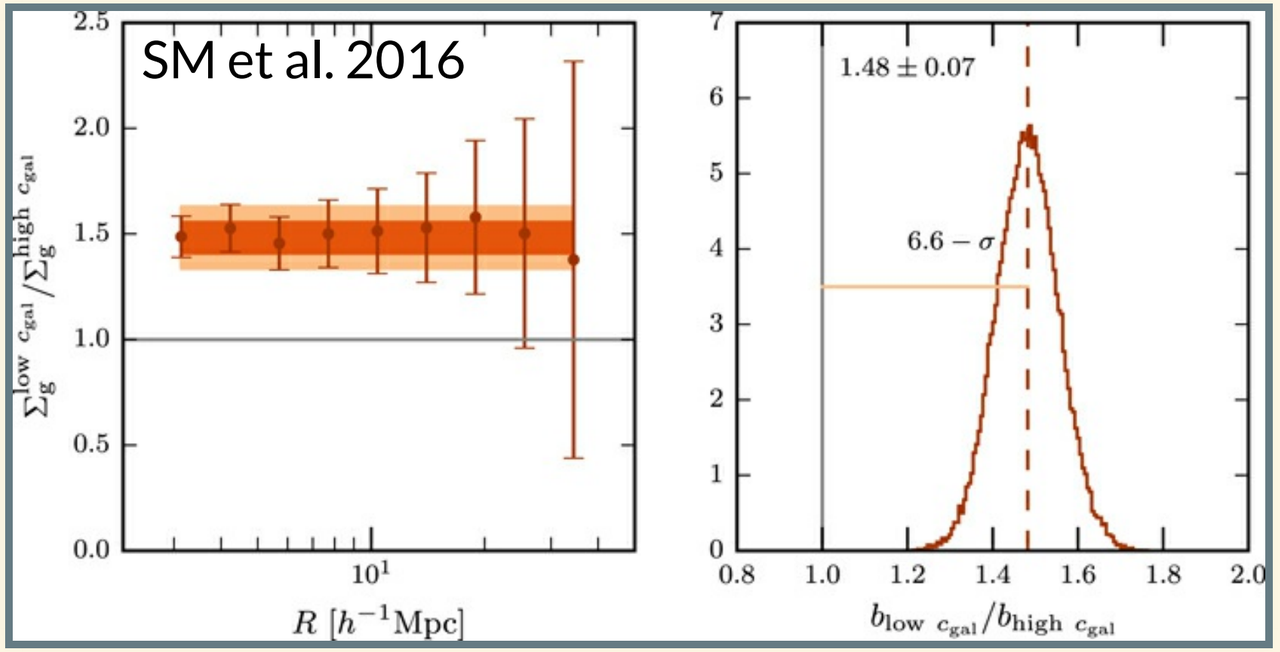
WEAK GRAVITATIONAL LENSING : SAMPLES WITH SAME HALO MASS

Miyatake, SM et al. 2016



- Both samples show similarity on small scales, but differences on large scales
- Halo occupation distribution modelling with free bias parameter
- Samples have same average halo mass, but different large scale bias

CLUSTER-GALAXY CROSS-CORRELATION



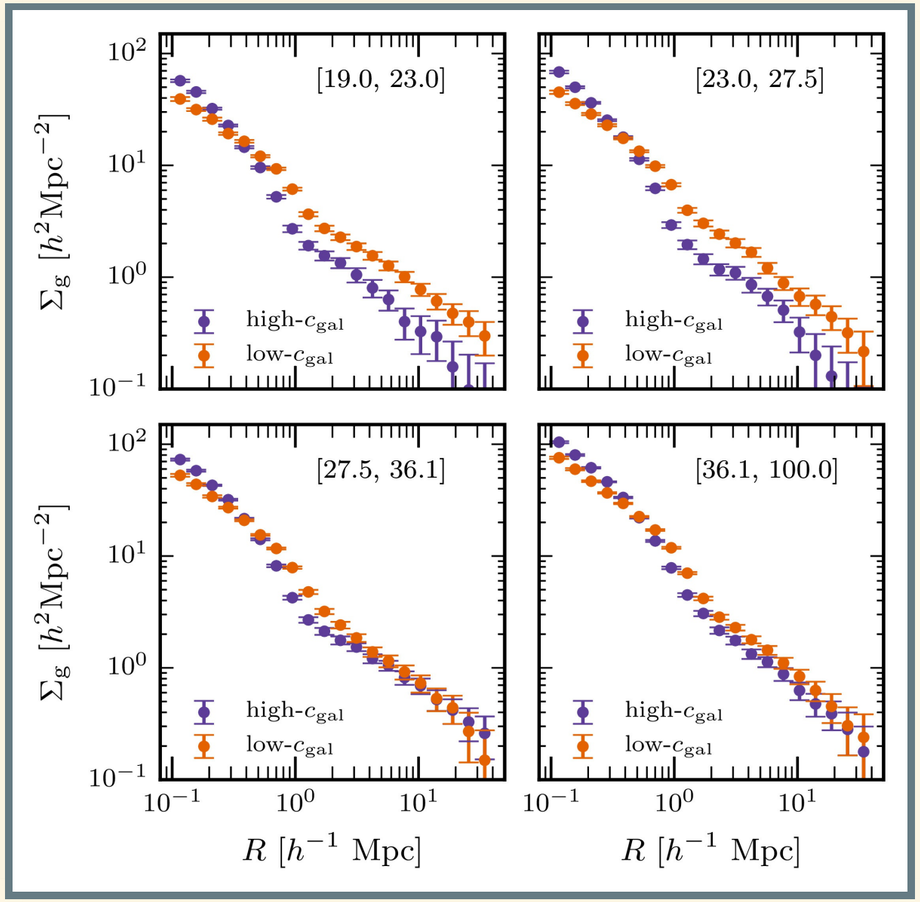
- **Projected clustering of galaxy clusters shows a significant and consistent difference as well**

R = 1.48 ± 0.07

BUT!

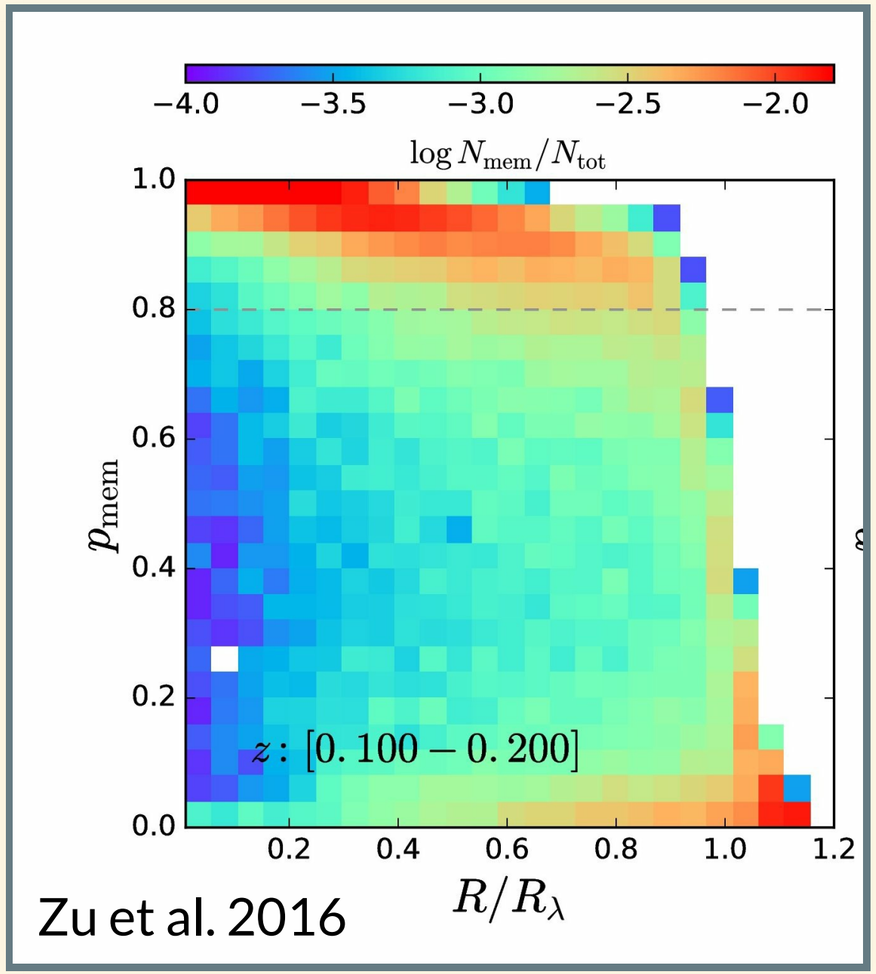
- Abstract of SM et al. 2016
  - ".. projection effects are not likely to be the sole source of these discrepancies. However, further investigations regarding unknown catastrophic weak lensing or cluster identification systematics are warranted."
- Search for mock catalogs on which Redmapper could be tested for this purpose

REDMAPPER AND PROJECTION EFFECTS



- First signs of observational difficulties, scaling with richness showed a troubling trend

REDMAPPER MEMBERSHIP PROBABILITIES

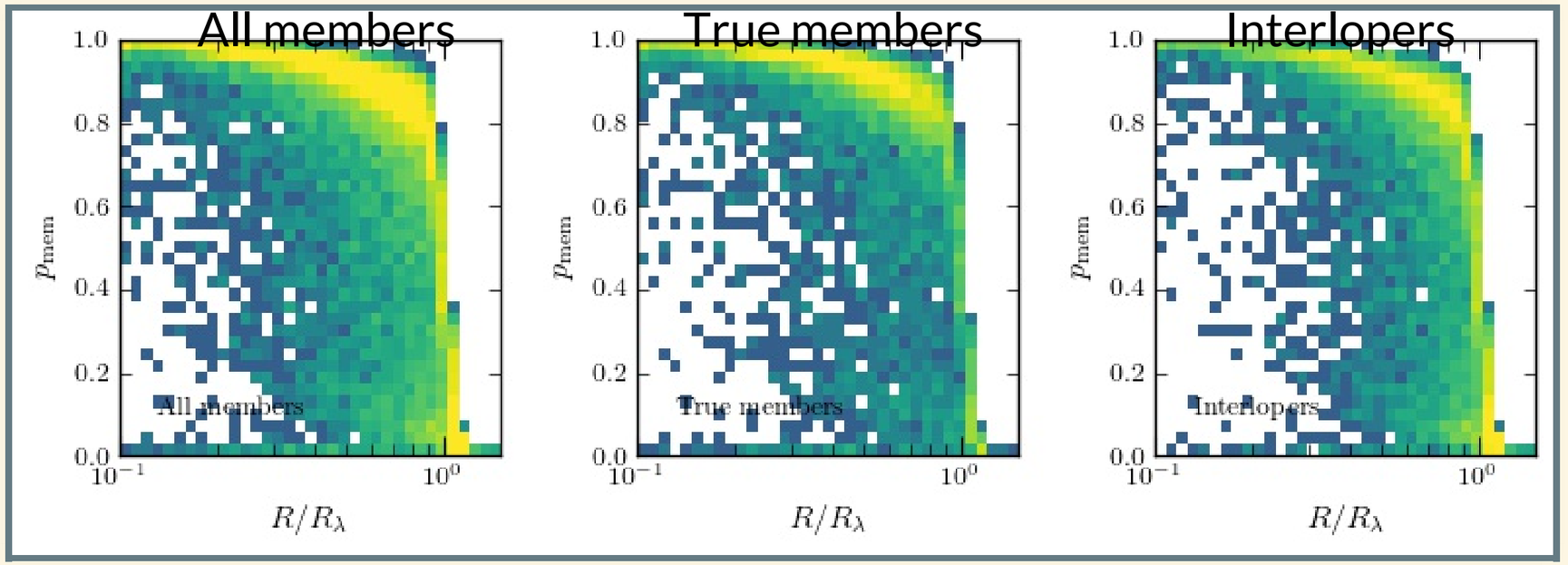


Zu et al. 2016

- Projection issues affect membership probabilities from Redmapper

- Proposed solution suggests cutting off membership probabilities at 0.8

REDMAPPER AND PROJECTION EFFECTS

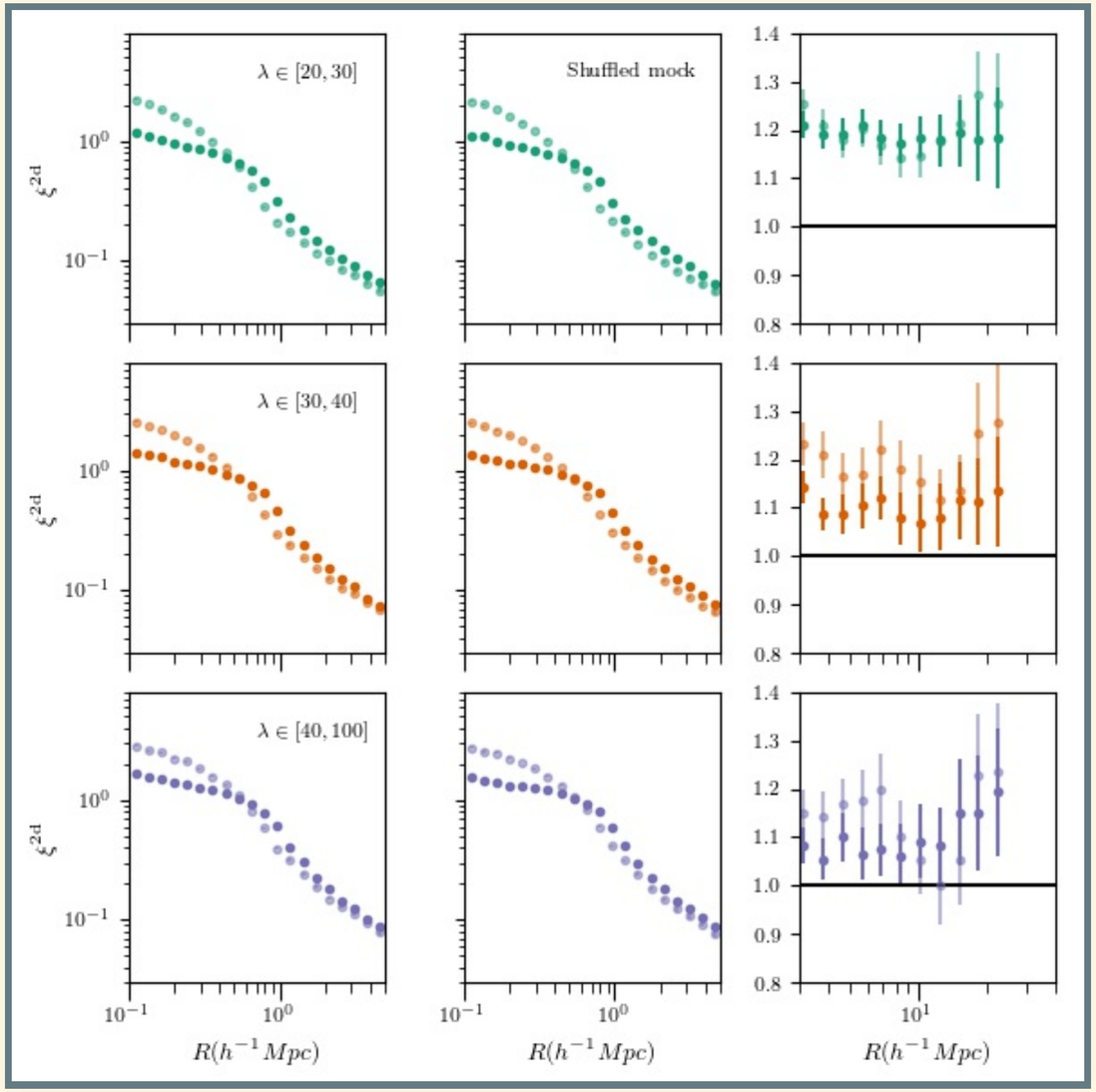


- However, a simple cut on p_{mem} cannot really distinguish members from interlopers
- Based on Redmapper run on a mock where colors were assigned based on density (Buzzard v1.0, courtesy Eli, Risa and co.)

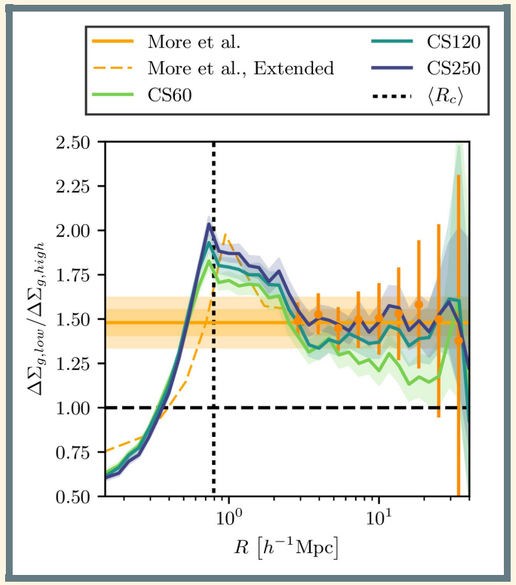
SIMPLE MOCK

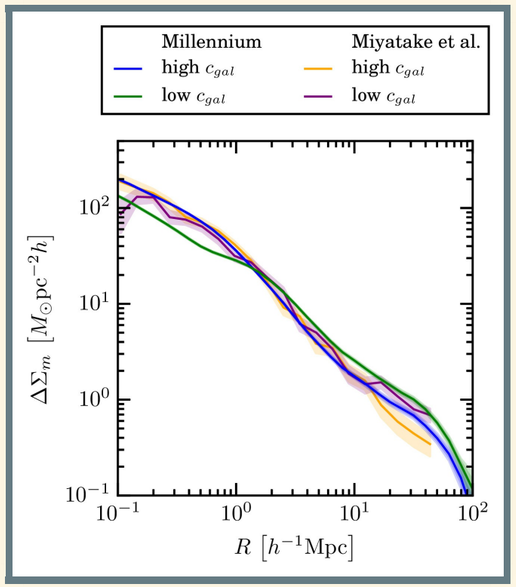
- Based on subhalos in dark matter only simulations (with no colors for galaxies) using the MultiDark Planck 2
    - Identify cluster members in projection iteratively, adapting the aperture to the number of galaxies in a cluster (as in redmapper)
    - Perform assembly bias measurements in mock with halo assembly bias erased by hand

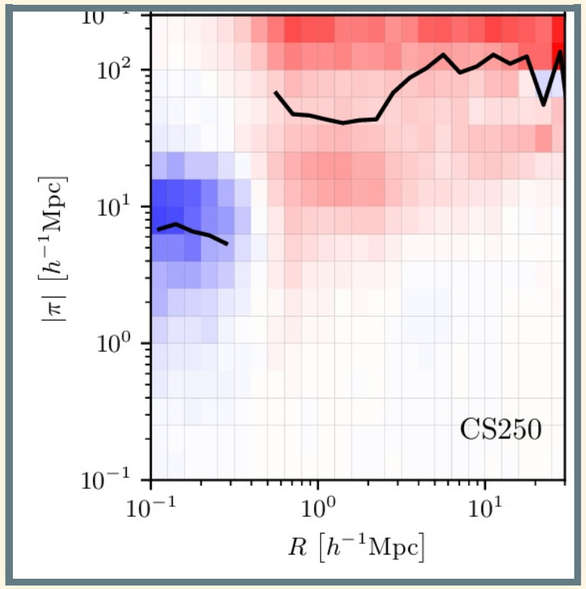
SIMPLE MOCK - REDMAPPER INDUCED ASSEMBLY BIAS



USING THE MILLENNIUM SEMI-ANALYTICAL MODEL

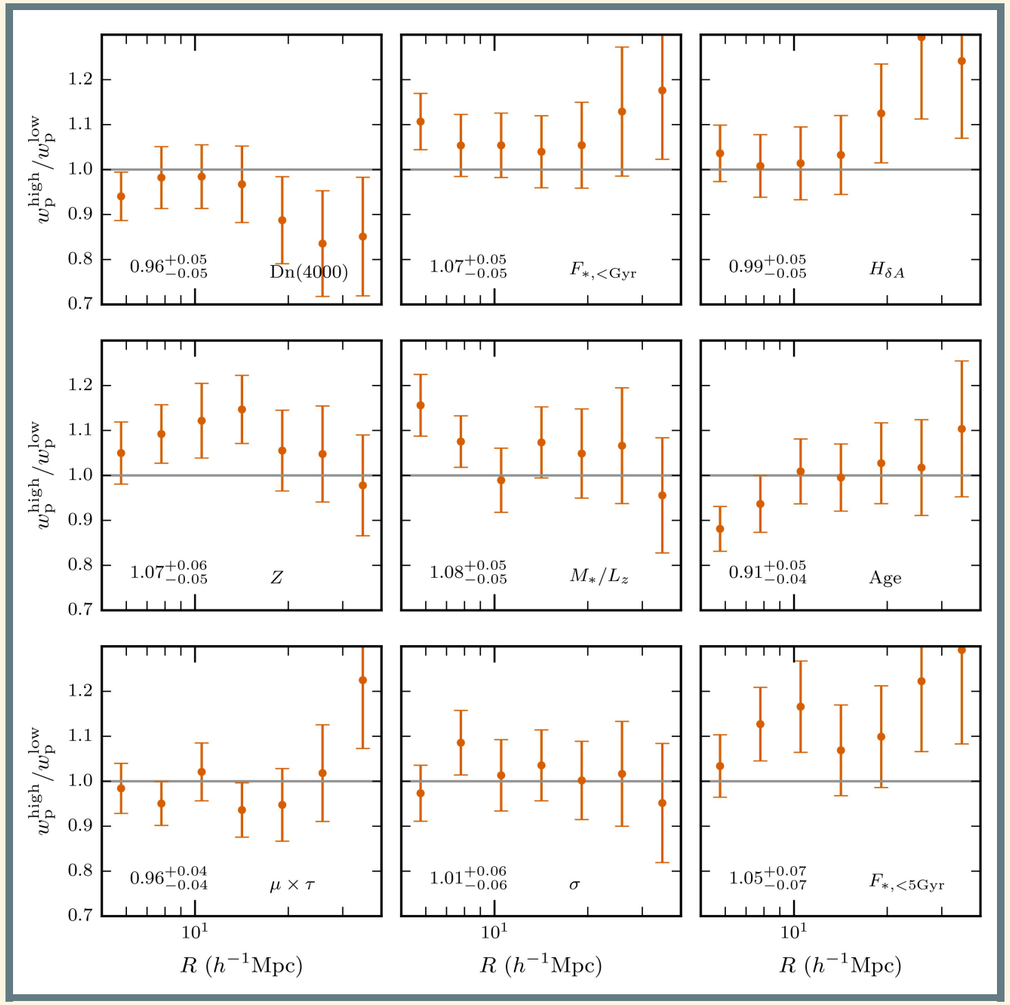






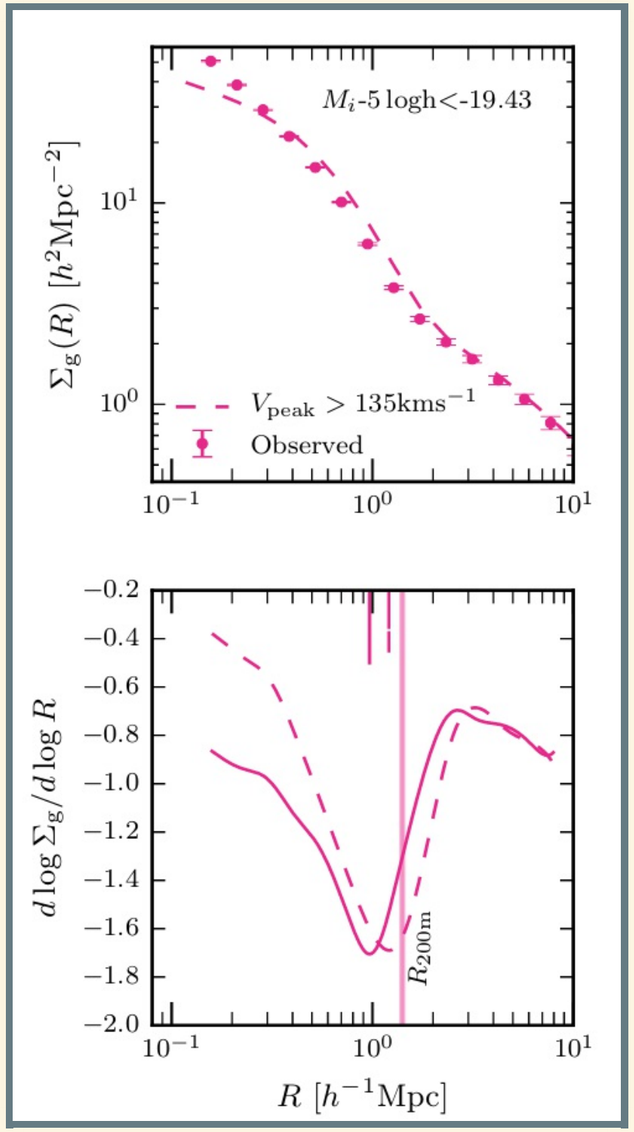
- Mock redmapper run on the Munich semi-analytical model (Busch & White 2017)
- Could reproduce the large assembly bias signal, but the weak lensing signals are not similar to that in data

HOW ABOUT USING PROPERTIES OF REDMAPPER BCGS?



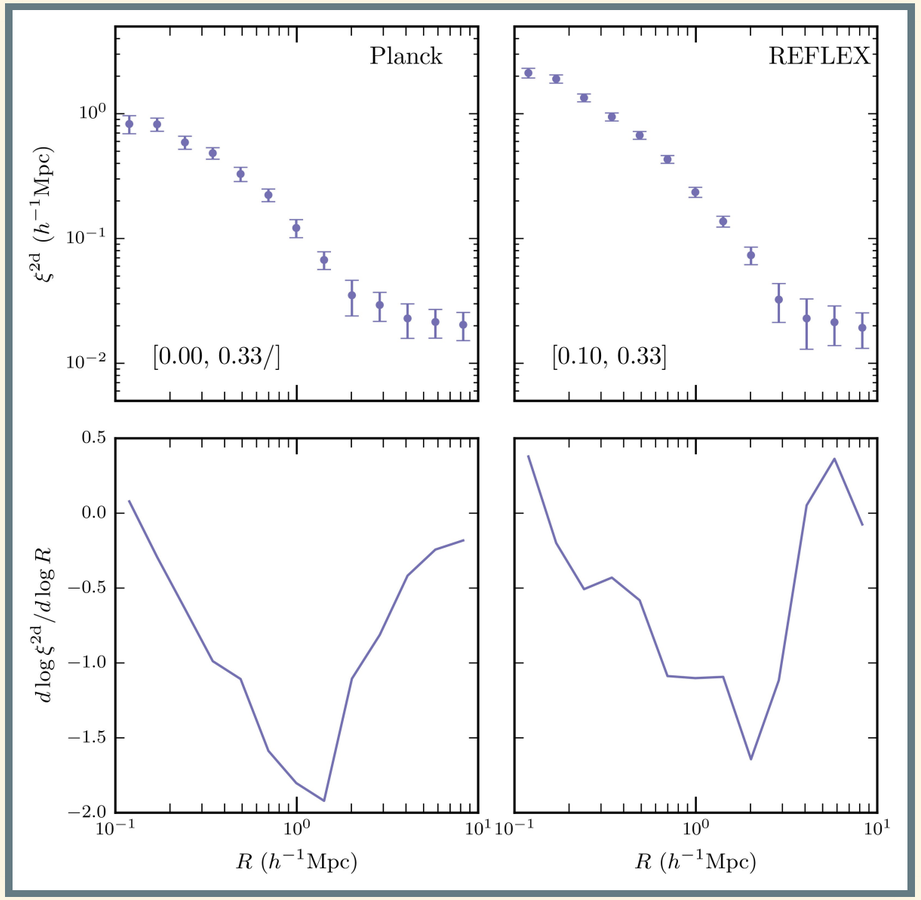
- Splits based physical properties derived from redmapper BCG spectra

SPLASHBACK RADIUS - DETECTION IN OBSERVATIONS



- Observed density drop in the galaxy distribution around redmapper clusters
- Location was about 20 percent smaller than what was expected around clusters of the measured halo mass
- Further supporting evidence based on red fractions (Baxter et al. 2017)
- However redmapper details could well be affecting conclusions here as well (Busch & White 2017)

XRAY AND SZ CLUSTERS



SM et al. (in prep)

- **Splashback-like features around Xray and SZ clusters (work in progress, limited by sample sizes currently)**

SUMMARY

- At fixed observed weak lensing mass, we detected a dependence of large scale clustering amplitude on the cluster centric distance of redmapper member galaxies.

- Interpreting this as manifestation of halo assembly bias as seen in simulations is marred by optical cluster finding systematics and membership contamination.

- Other BCG properties do not seem to give a large assembly bias signal.

- Conclusions about the splashback radius may also have to be revisited based on realistic mocks for redmapper.