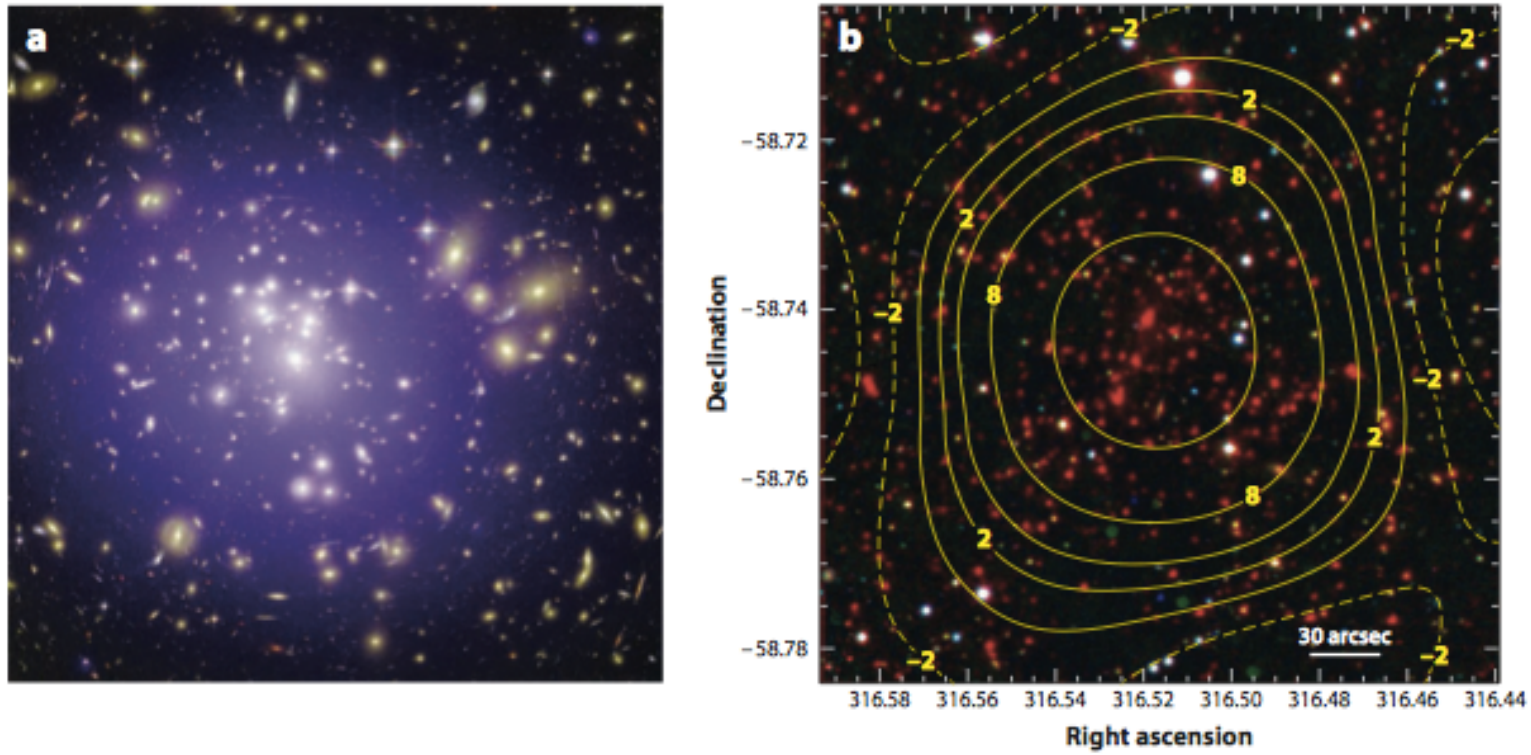

Red-Sequence Evolution of Galaxy Clusters

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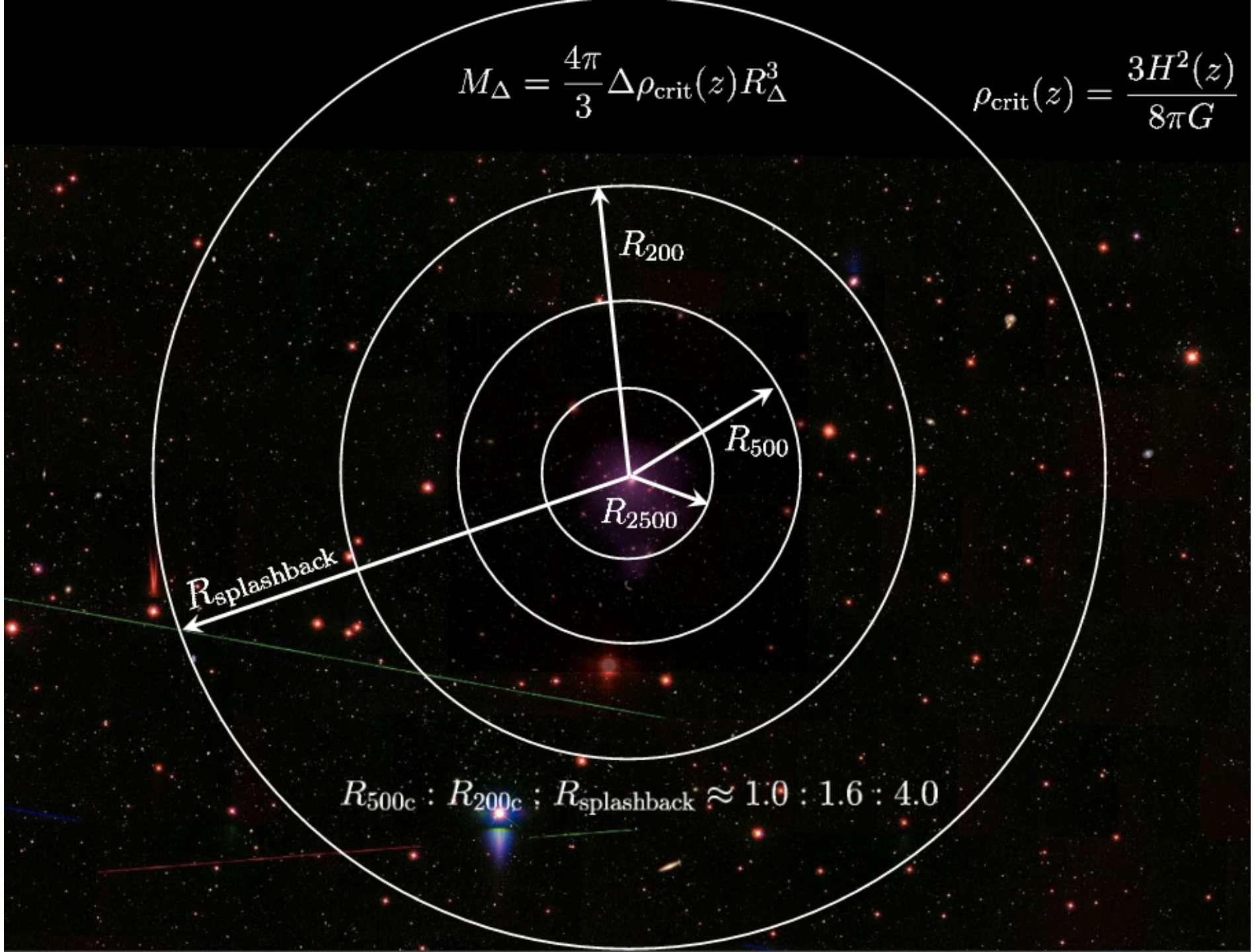
with Lindsey Bleem and Mike Gladders

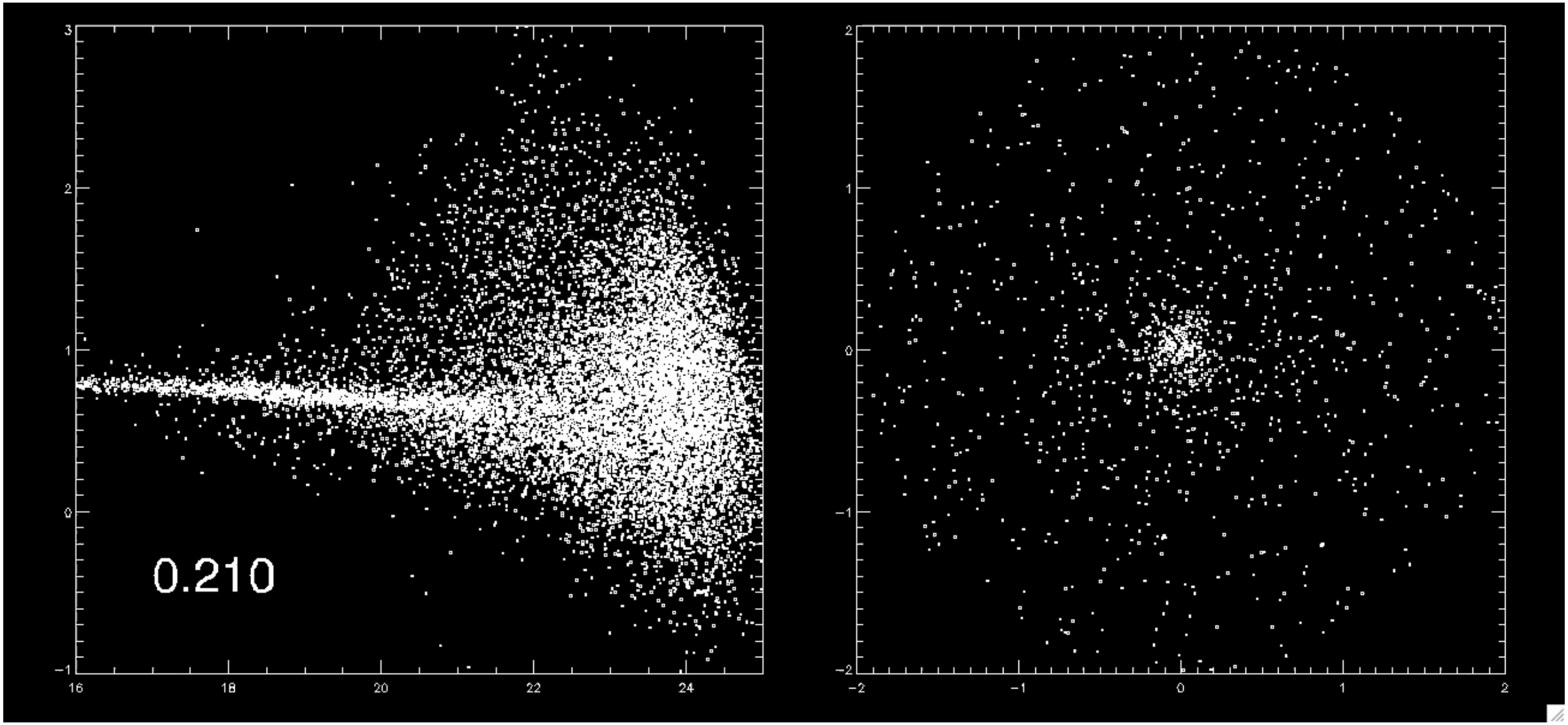
KICP, University of Chicago

Outline : Astrophysics and Cosmology

- Motivation
  - SPT,DES Projects
  - A DES Class Project Illustration, Autumn 2016, University of Chicago
- Cosmology with Galaxy Clusters – Membership,Richness, Mass
- This work
  - Datasets
  - Datacuts – selection functions
  - Analysis
- Red Sequence Evolution in motion


$M_\Delta = \frac{4\pi}{3}\Delta\rho_{\rm crit}(z)R_\Delta^3$
$\rho_{\rm crit}(z) = \frac{3H^2(z)}{8\pi G}$
R_{200}
R_{500}
R_{2500}
$R_{\rm splashback}$
$R_{500c} : R_{200c} : R_{\rm splashback} \approx 1.0 : 1.6 : 4.0$

A. Kravtsov

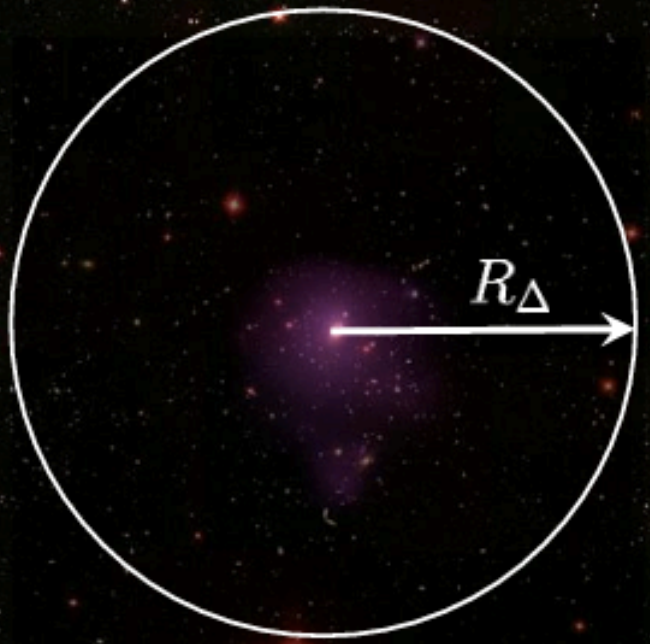


Gladders et al. – Red Sequence Cluster Survey

Concepts: An Overview

$$M_\Delta = \frac{4\pi}{3}\Delta\rho_{\rm ref}(z)R_\Delta^3$$

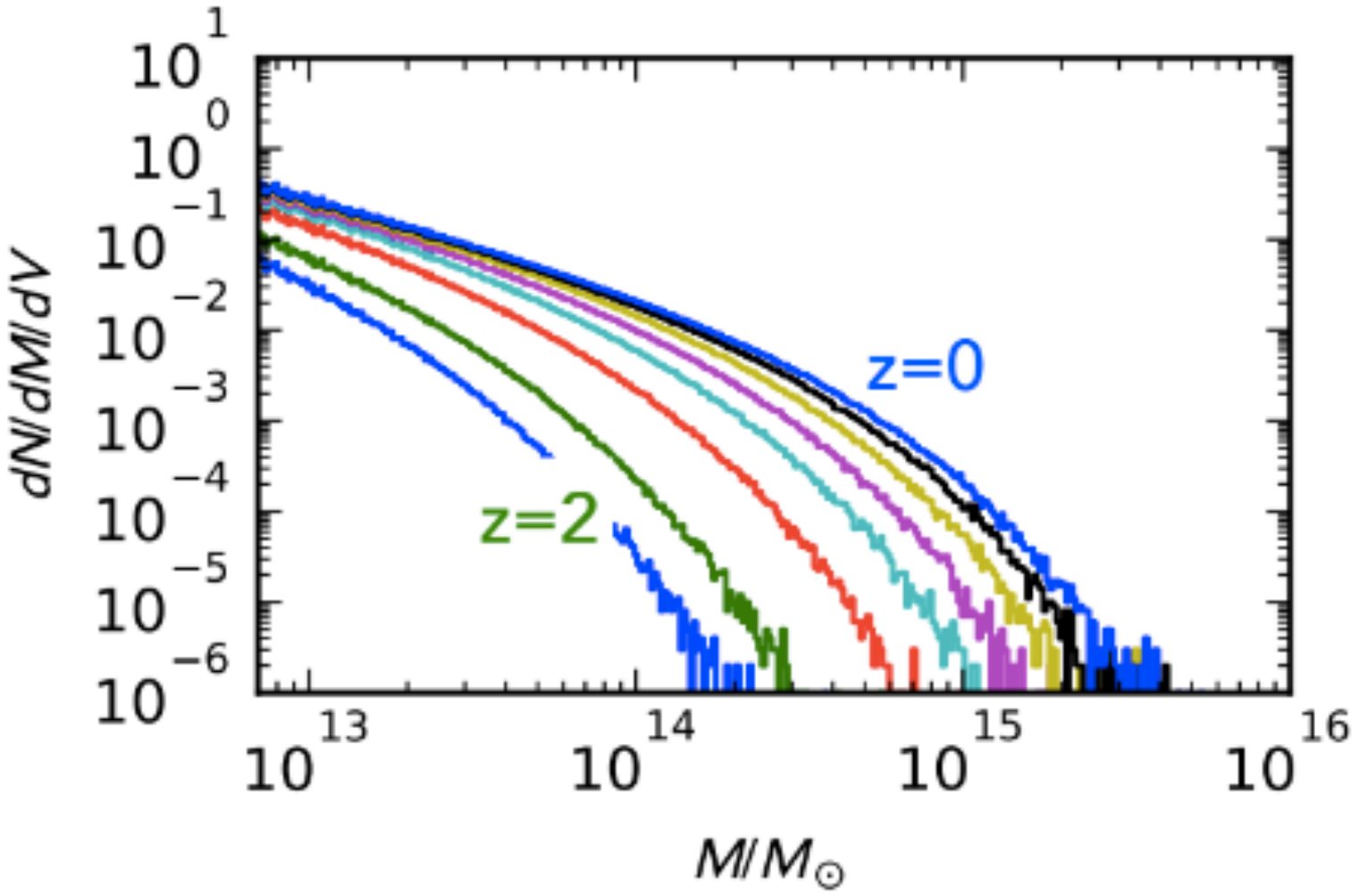
$$T \propto \frac{M_\Delta}{R_\Delta} \propto \Delta^{1/3}\rho_{\rm ref}^{1/3}(z)M_\Delta^{2/3} \begin{cases} \propto \rho_{\rm crit}^{1/3}(z)M_{\Delta{\rm c}}^{2/3} \propto E^{2/3}(z)M_{\Delta{\rm c}}^{2/3} \\ \propto \rho_{\rm mean}^{1/3}(z)M_{\Delta{\rm m}}^{2/3} \propto (1+z)M_{\Delta{\rm m}}^{2/3} \end{cases}$$



$$\mu m_p \frac{GM_{\rm HE}(<R)}{R} = kT(R)\left[-\frac{d\ln\rho_{\rm g}}{d\ln R} - \frac{d\ln T}{d\ln R}\right]$$

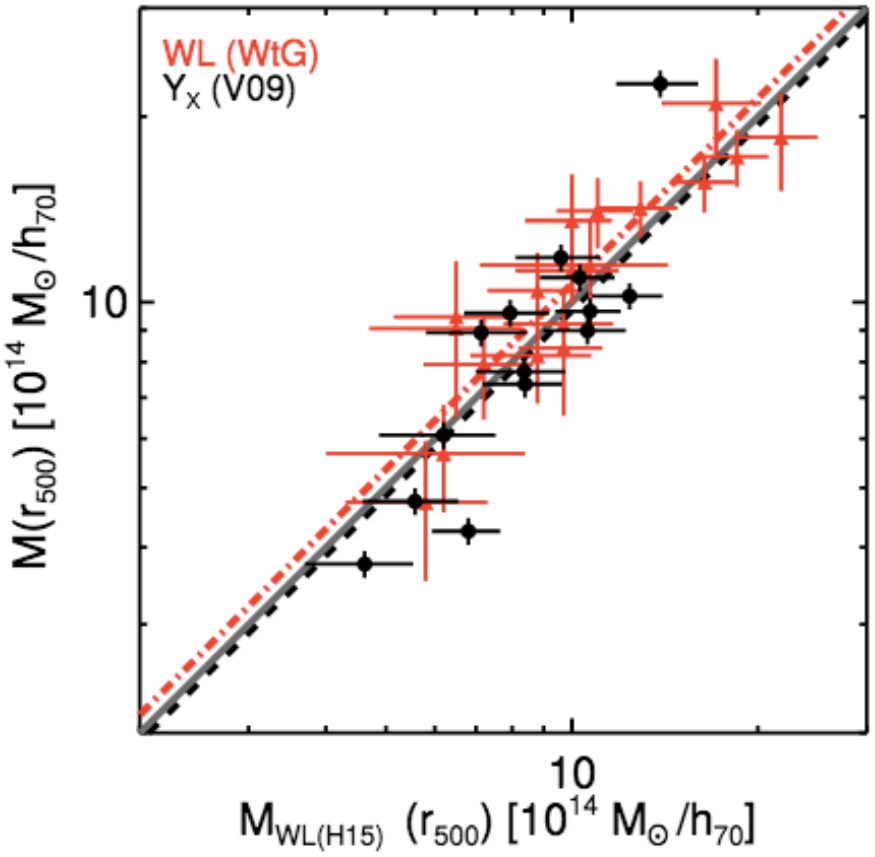
$$\frac{GM_{\rm J}(<R)}{R} = \sigma_r^2(R)\left[-\frac{d\ln n_{\rm gal}}{d\ln R} - \frac{d\ln\sigma_r^2}{d\ln R} - 2\beta(R)\right]$$

Halo Mass Function

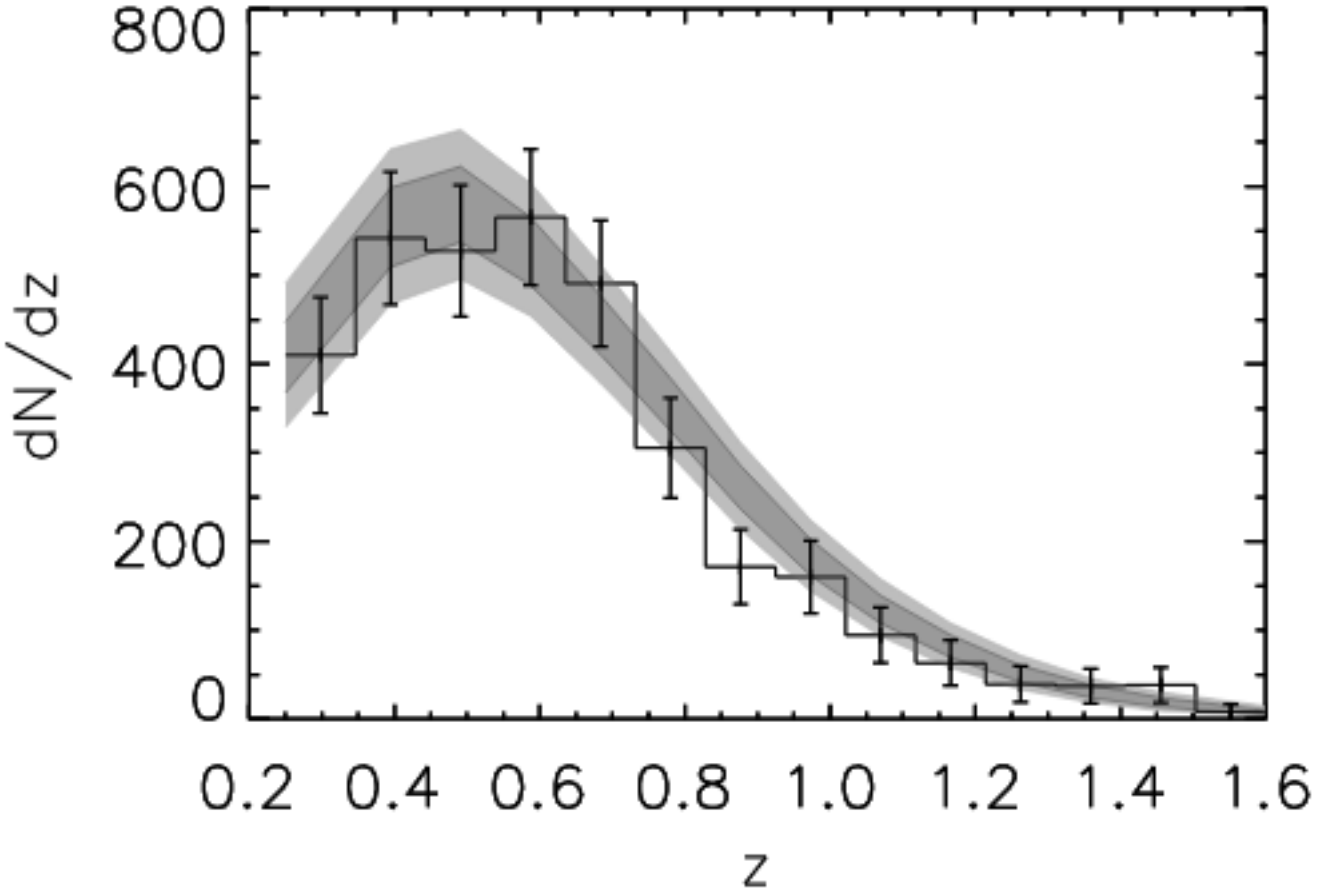


Boucquet et al.

Current Constraints

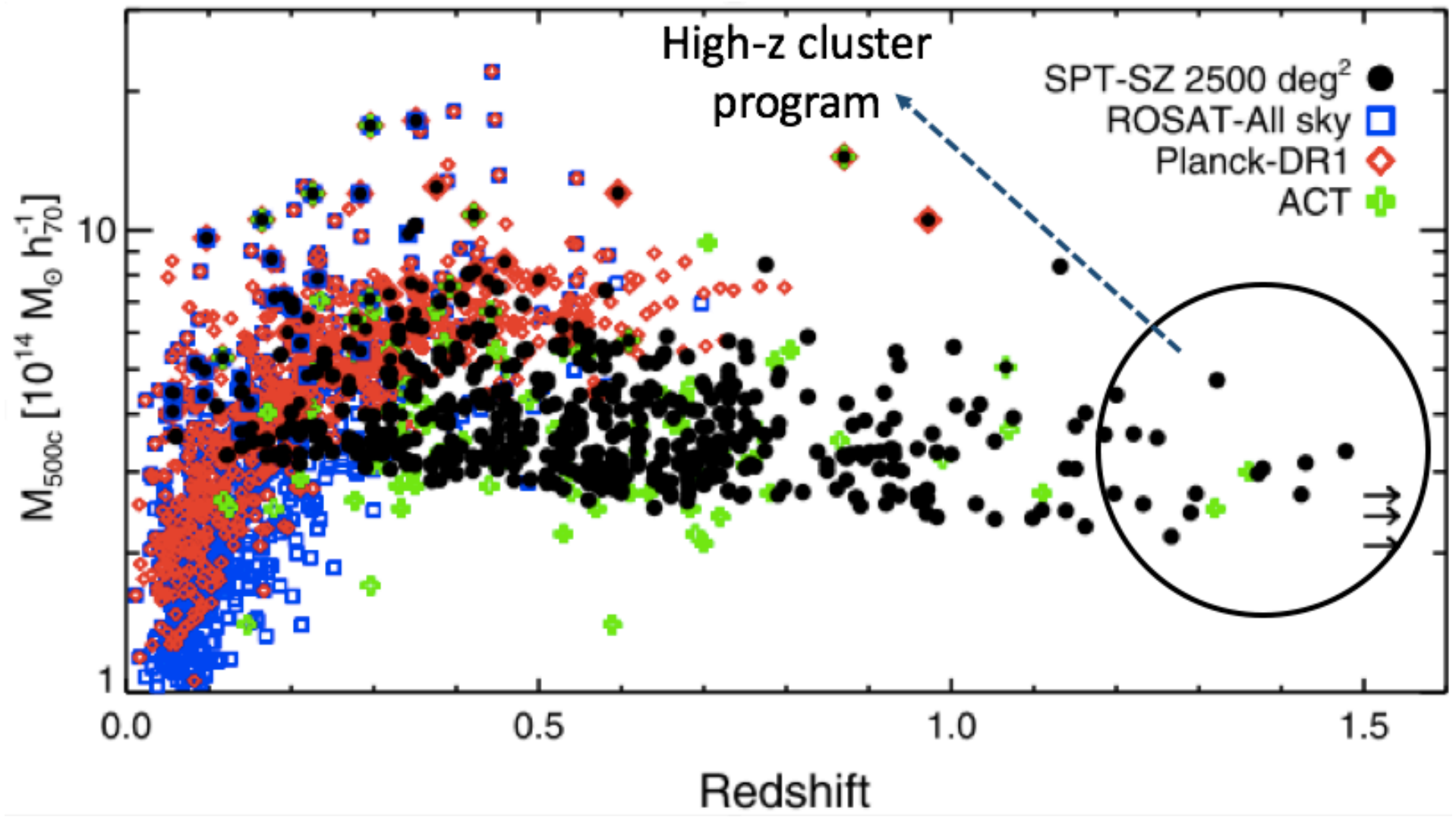


WtG, Allen, Mantz et al



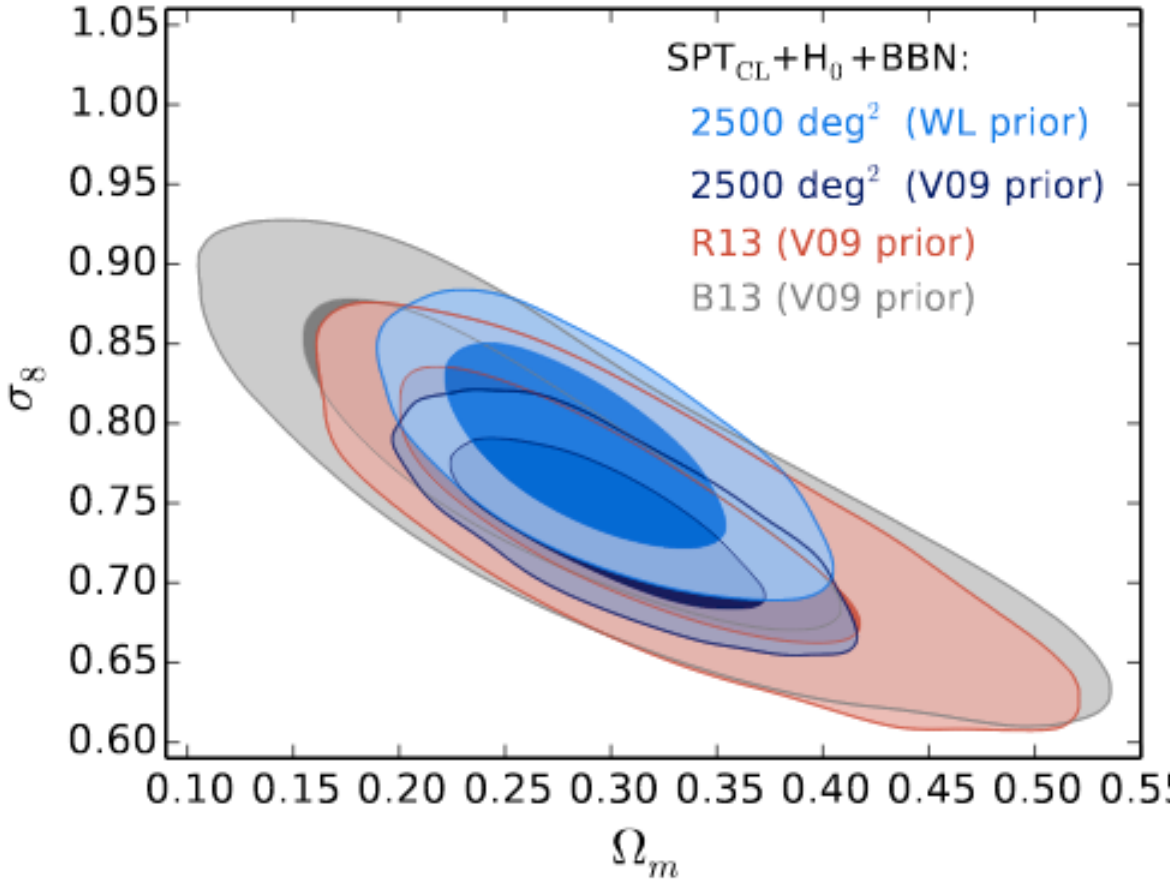
SPT, deHaan et al. 2017

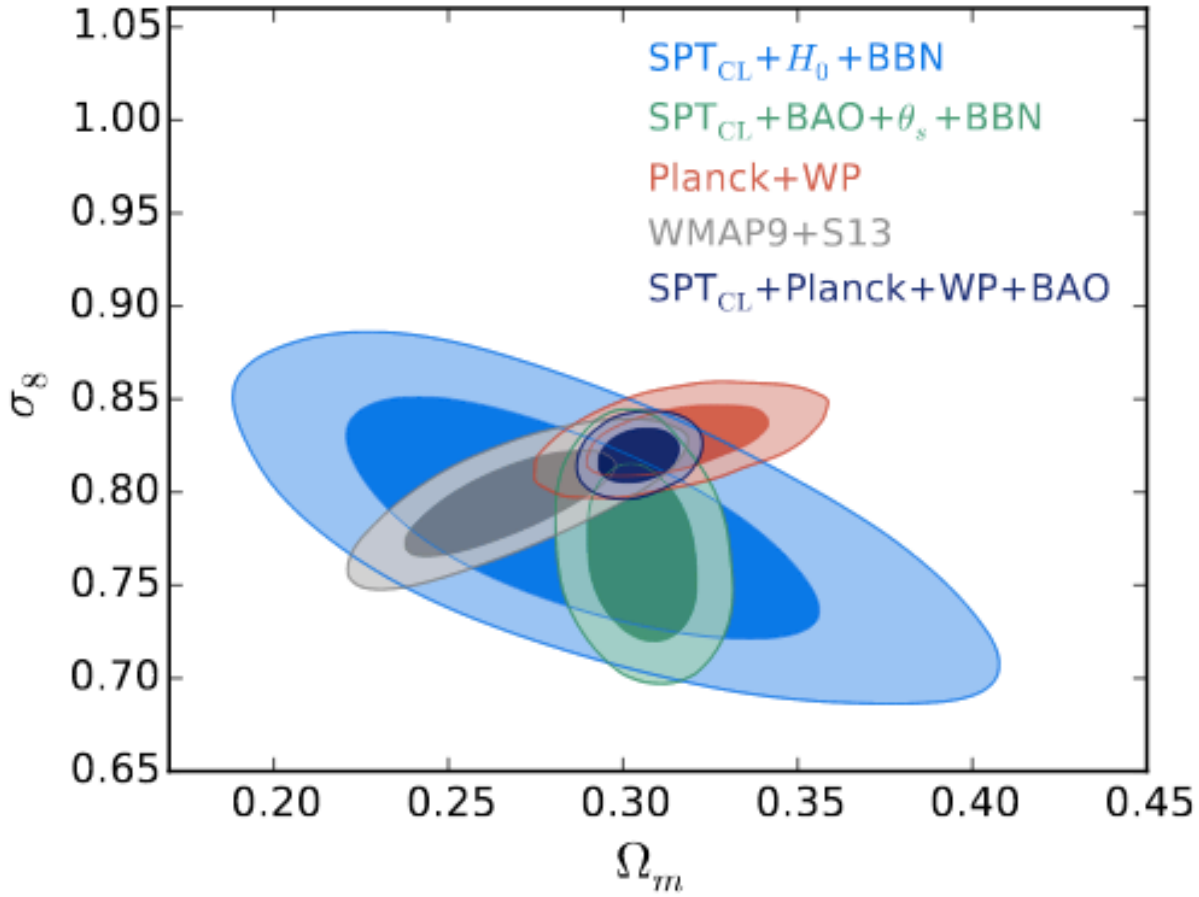
SPT-SZ Cosmology



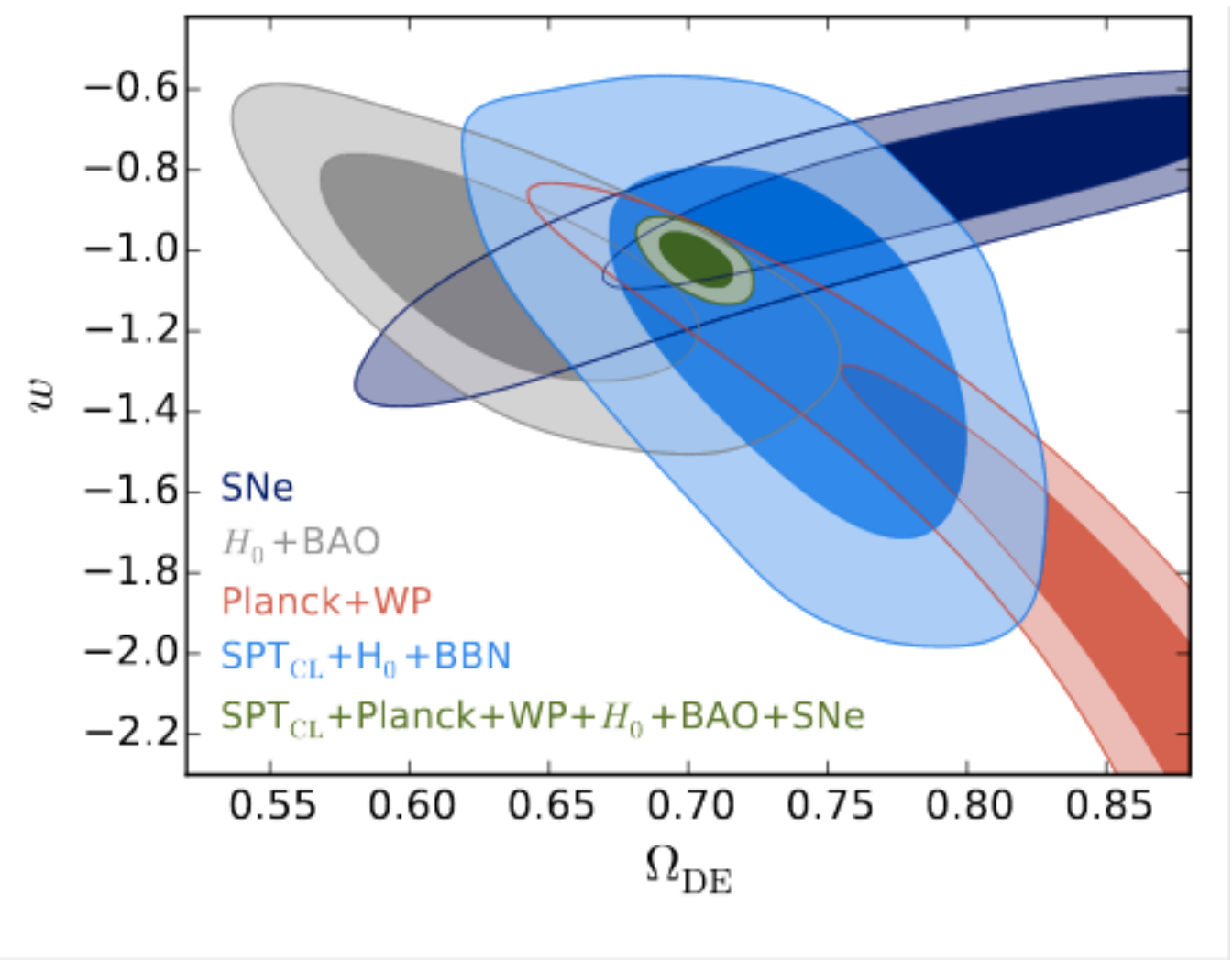
Bleem et al. 2015

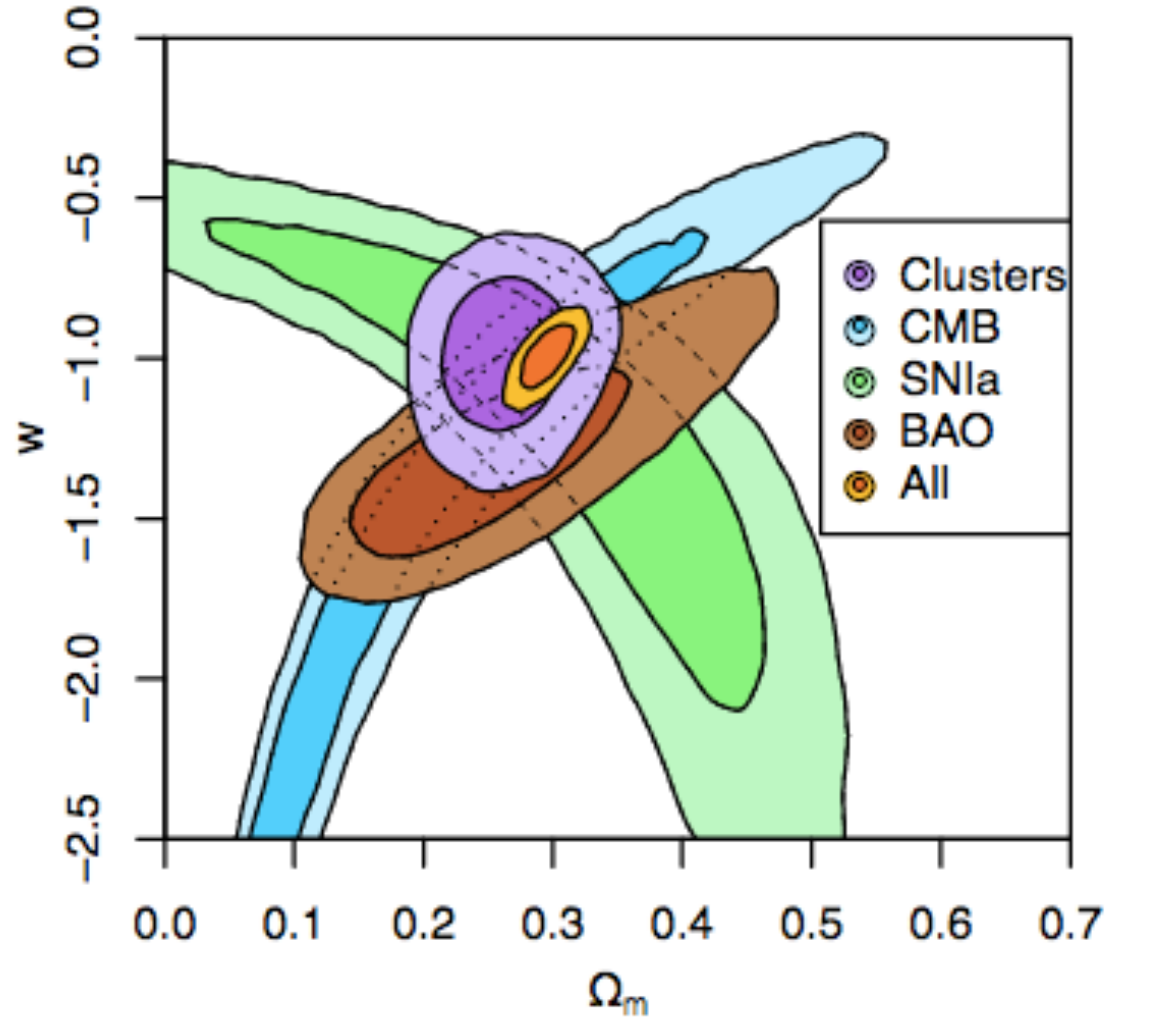
SPT-SZ Cosmology





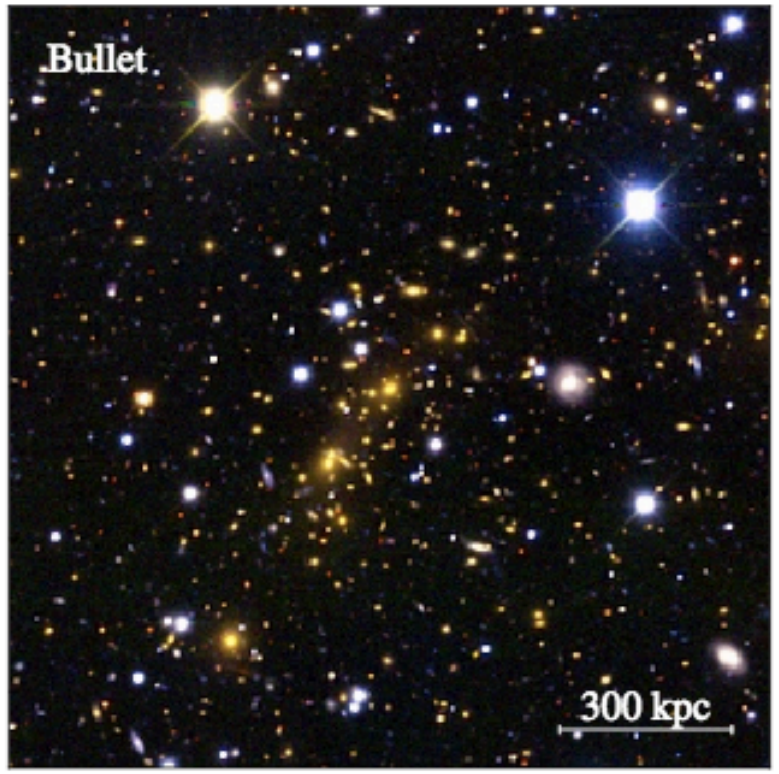
de Haan et al. 2017

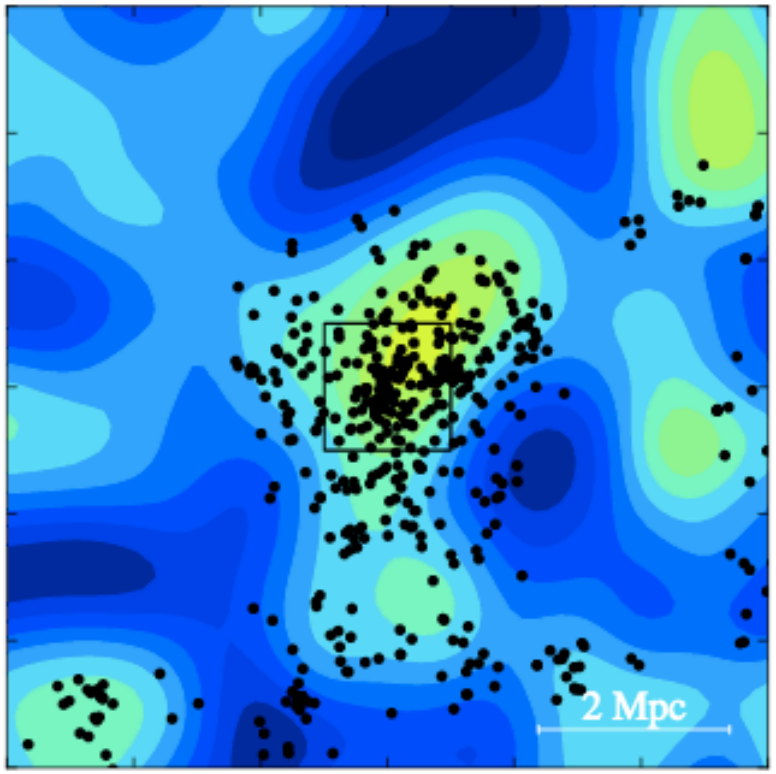

w
−0.6
−0.8
−1.0
−1.2
−1.4
−1.6
−1.8
−2.0
−2.2
0.55
0.60
0.65
0.70
0.75
0.80
0.85
$\Omega_{\rm DE}$
SNe
H_0+BAO
Planck+WP
SPT$_{\rm CL}$+H$_0$+BBN
SPT$_{\rm CL}$+Planck+WP+H_0+BAO+SNe

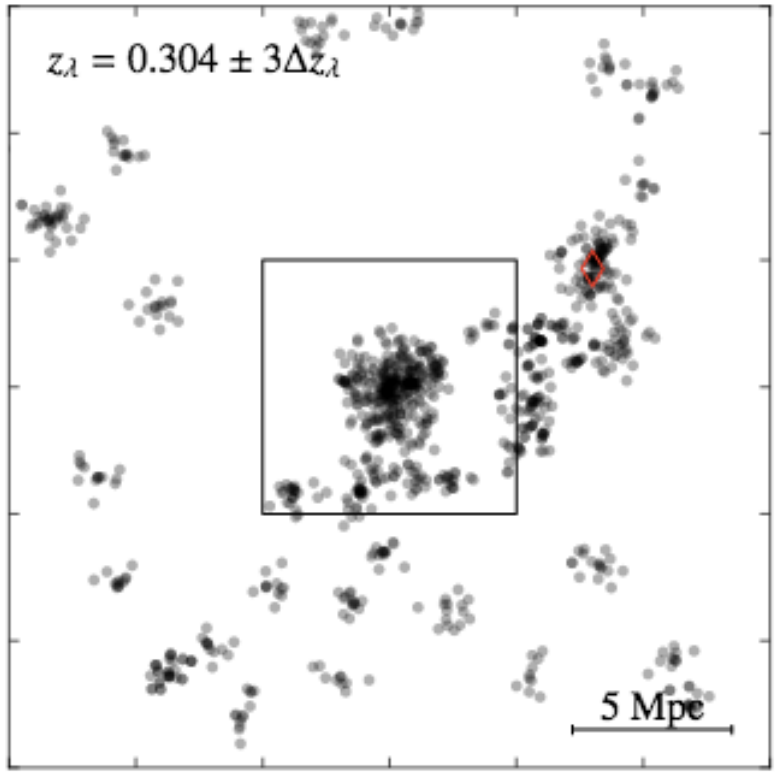

w
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
Ω_m
Clusters
CMB
SNIa
BAO
All

This Work

DES RedMapper Galaxy Clusters



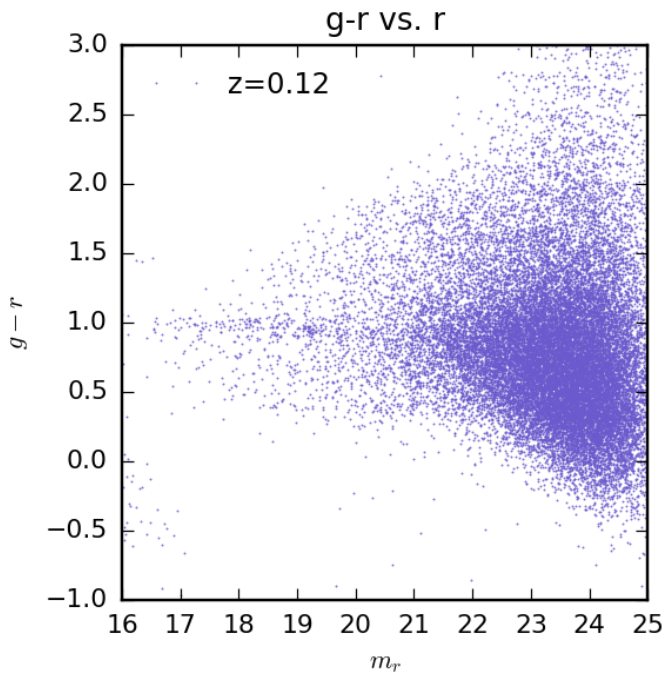


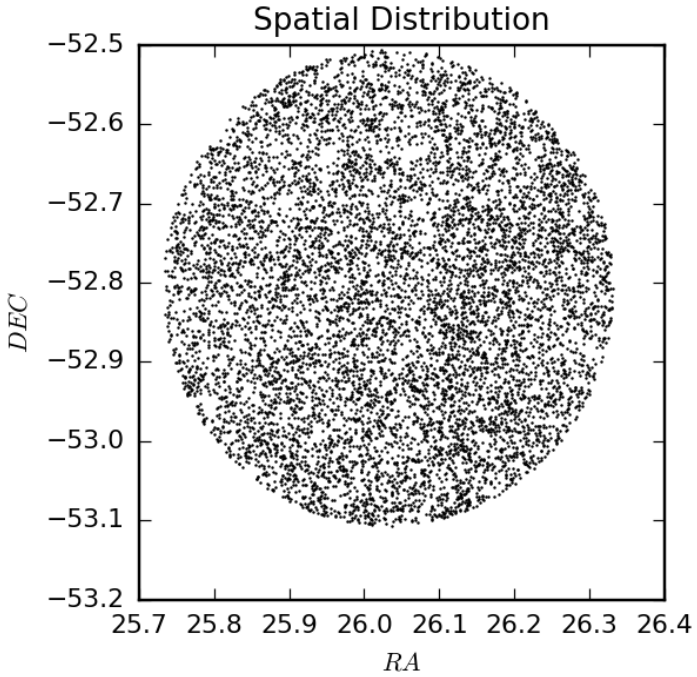


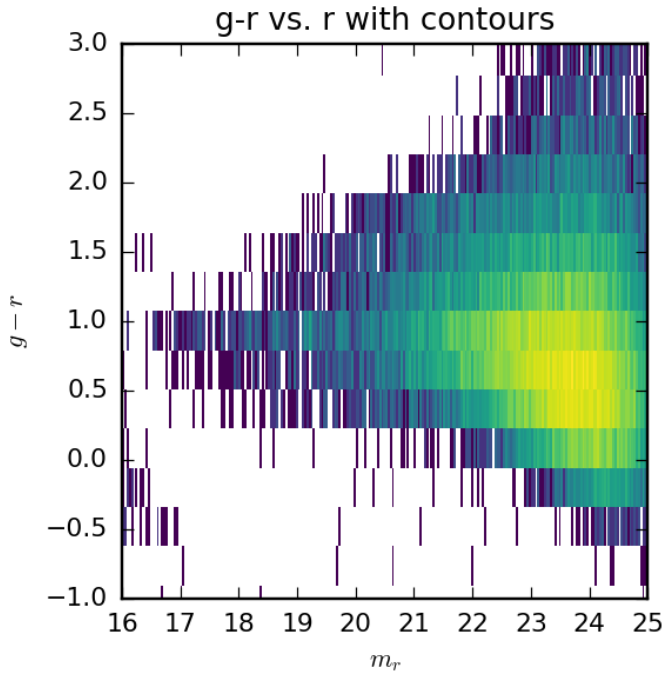
ΔDec

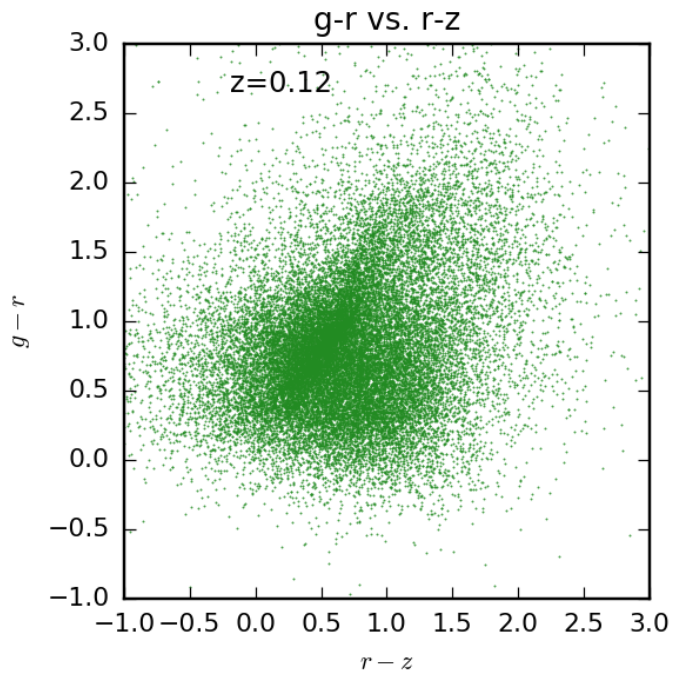
DES Redmapper

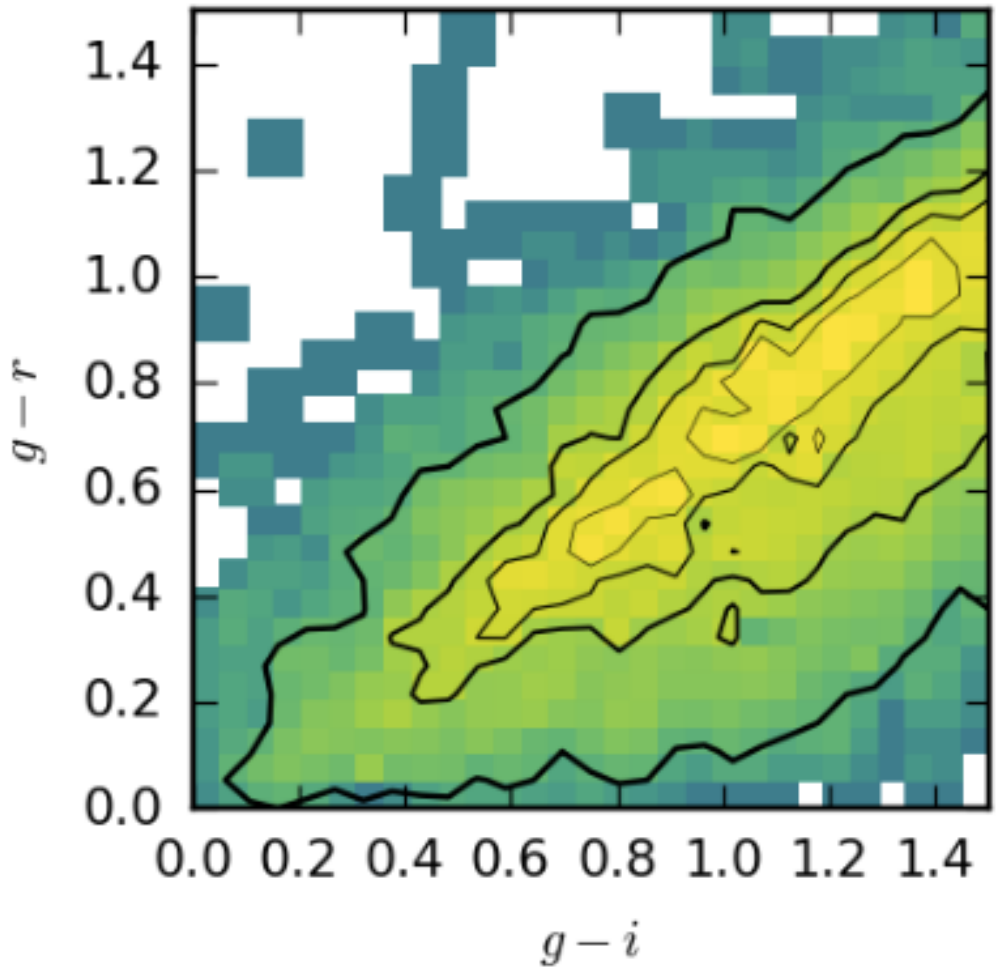
Example: SPT Cluster in DES





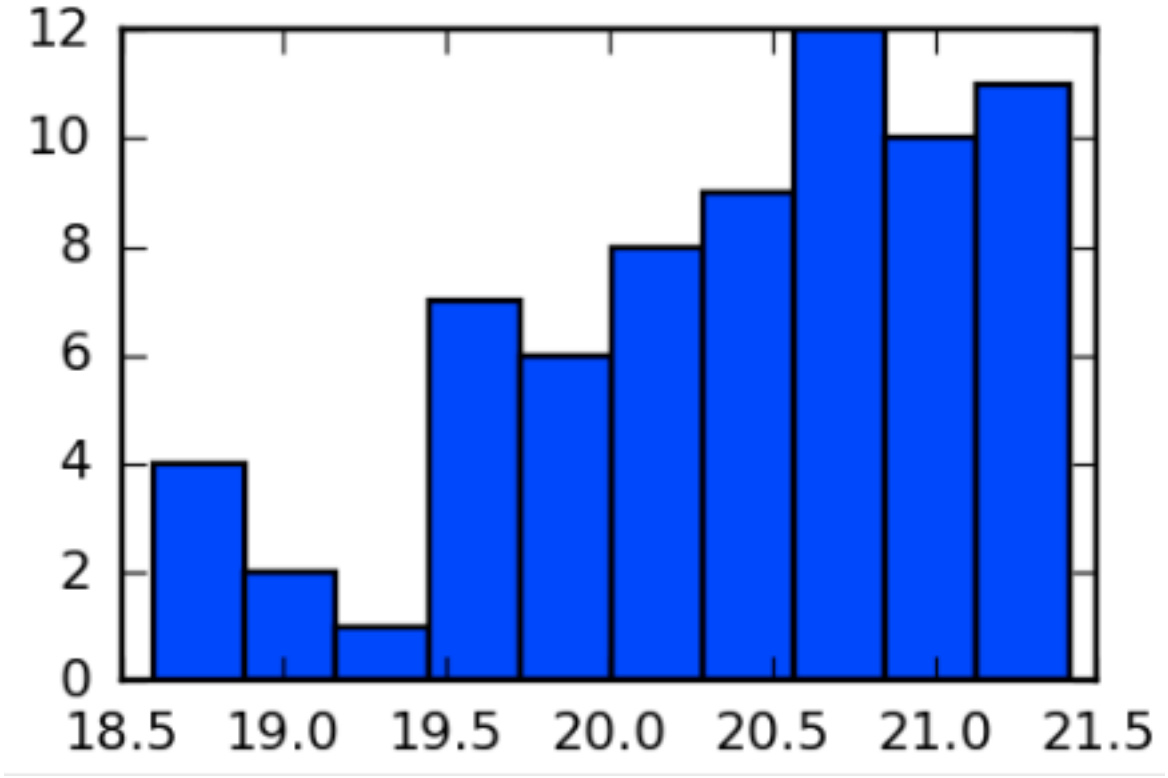




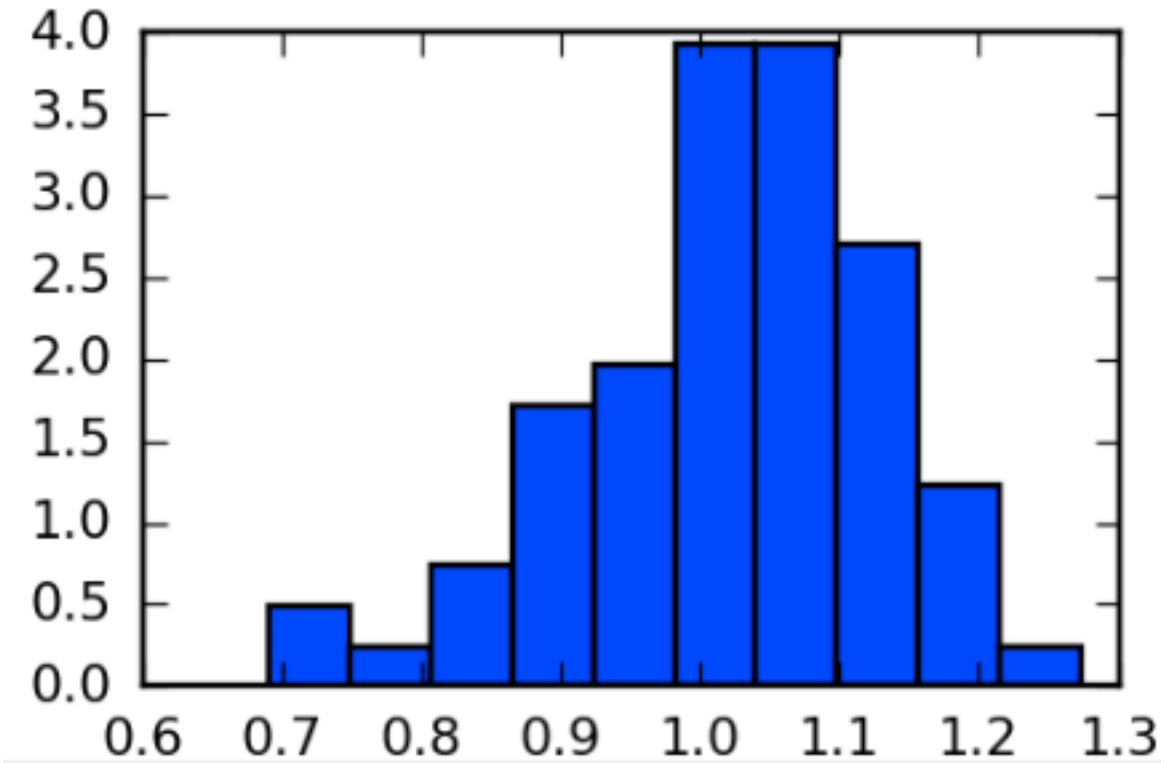


GK

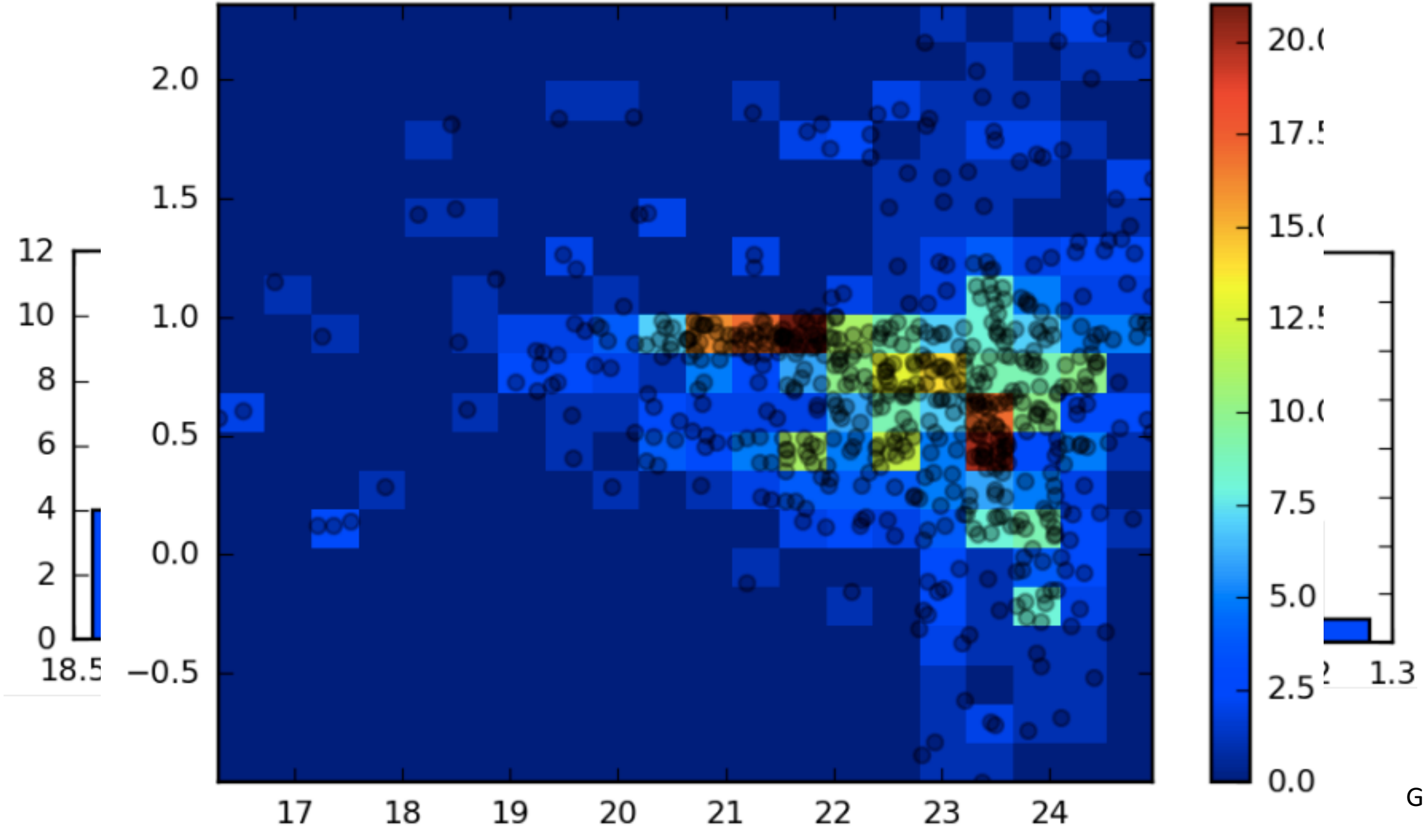
Distribution in color-magnitude space : 1 Cluster Tile



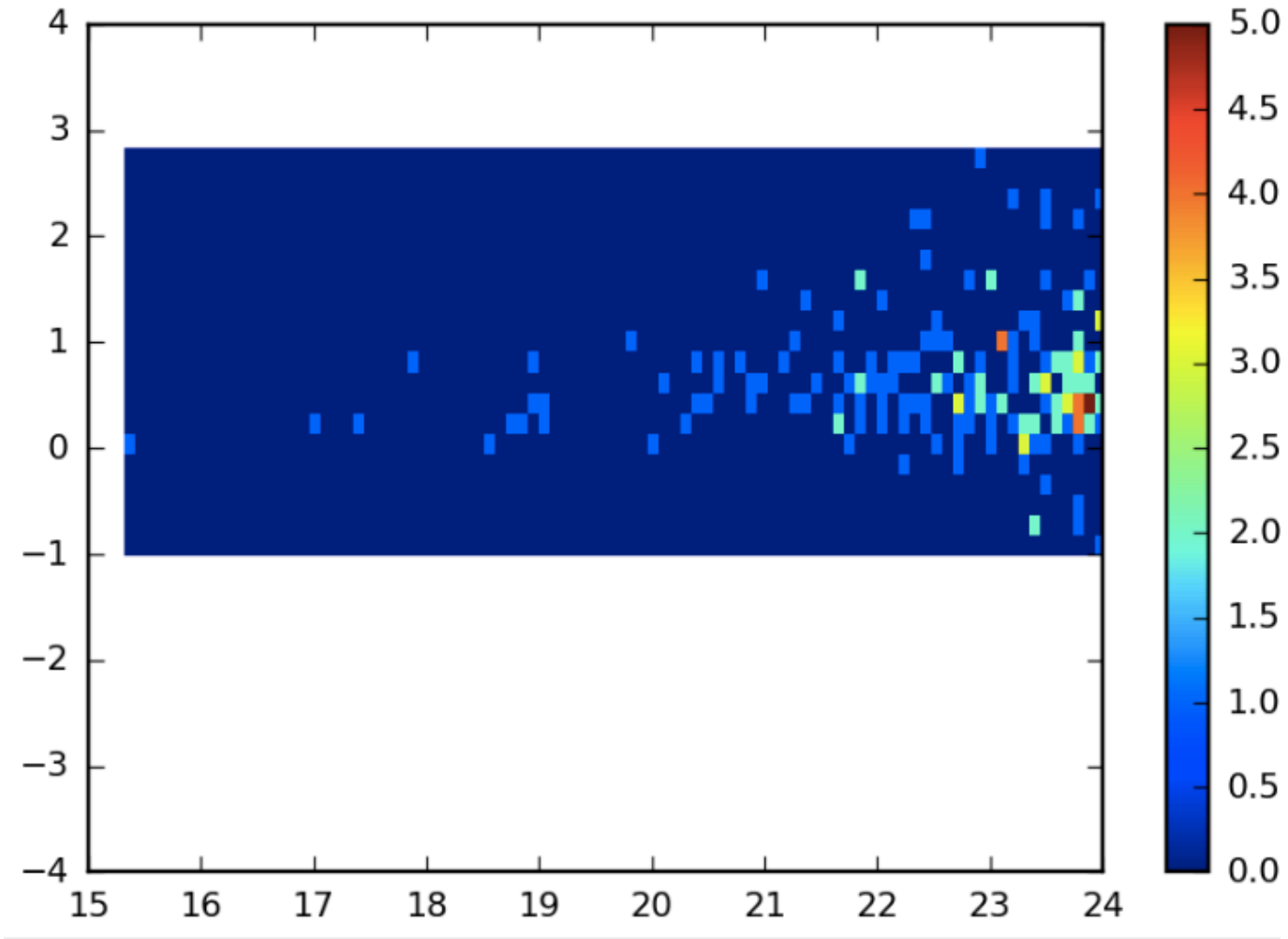
Mr



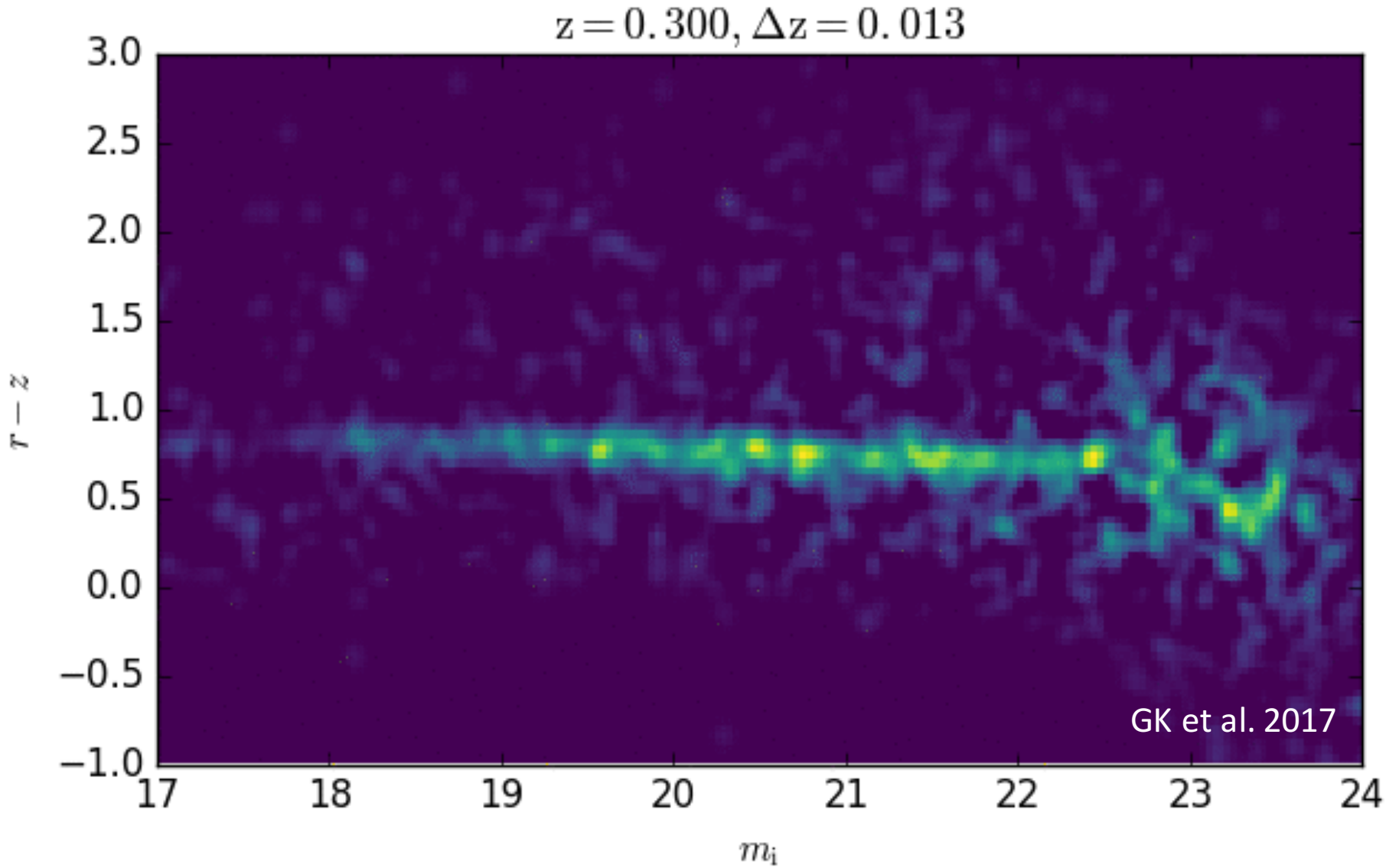
r-z


2.0
1.5
1.0
0.5
0.0
−0.5
17
18
19
20
21
22
23
24
12
10
8
6
4
2
0
18.5
20.0
17.5
15.0
12.5
10.0
7.5
5.0
2.5
0.0
1.3
GK

Background contamination



Final product: Red Sequence Evolution with z


$z = 0.300, \Delta z = 0.013$
3.0
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
$r - z$
17
18
19
20
21
22
23
24
m_i
GK et al. 2017