COSMOLOGY WITH GALAXY CLUSTERS IN DES
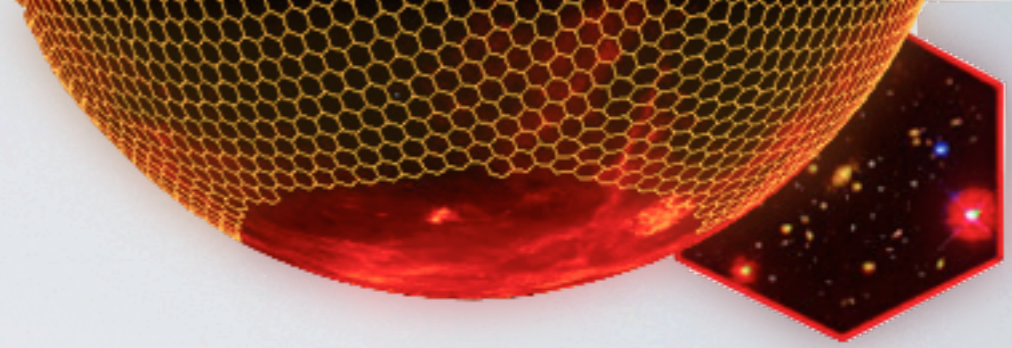
Marcelle Soares-Santos

🔀 Fermilab

DPF 2013 ◆ Santa Cruz ◆ August 16, 2013

GALAXY CLUSTERS
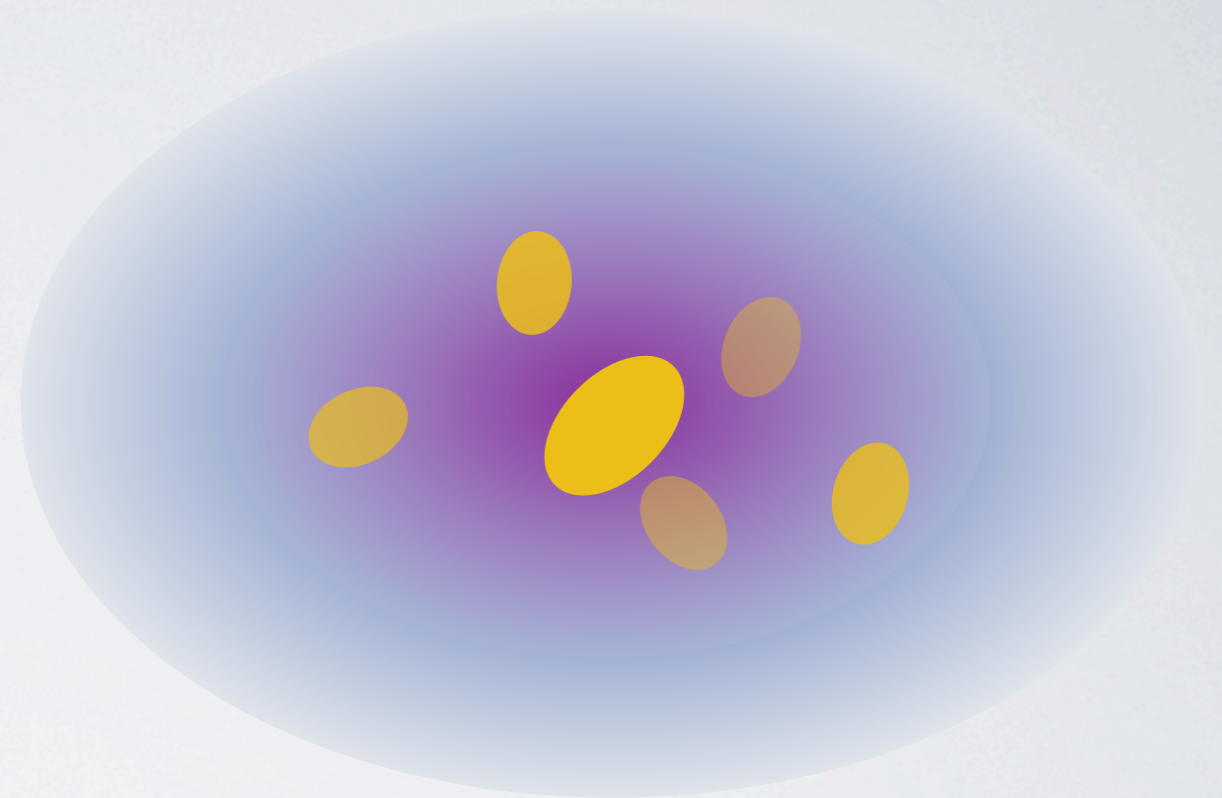
Largest gravitationally bound
structures in the Universe

$\sim 10^{13} - 10^{14}$ solar masses:

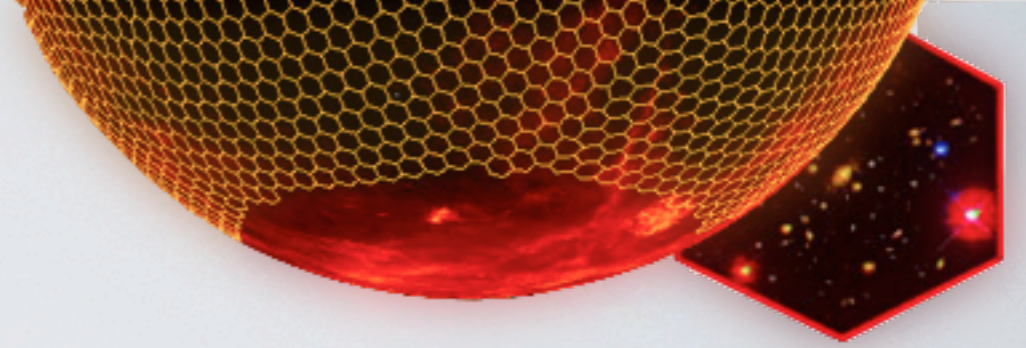**~80% Dark Matter**
~20% hot diffuse gas
~1% galaxies

Cluster number density as a function of mass and redshift is
very sensitive to cosmology.
— angular diameter distance (**volume**)
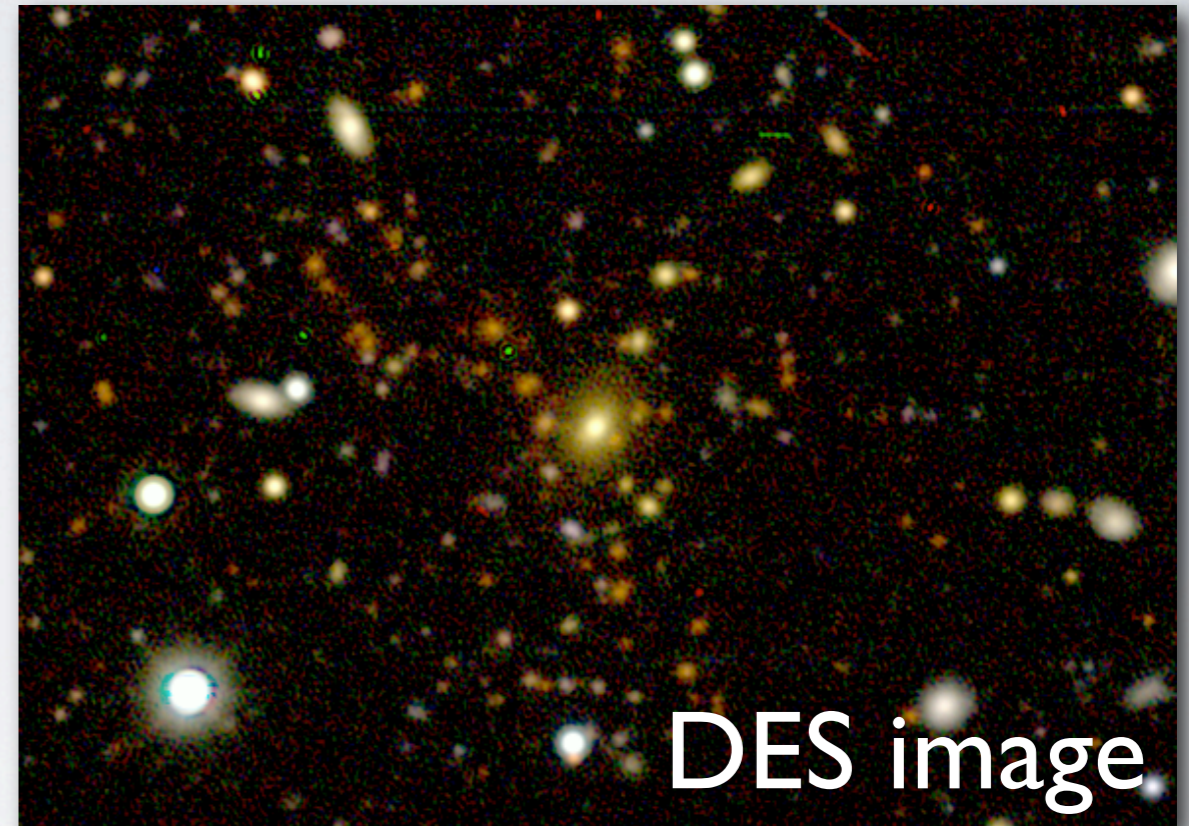— growth of structure (**galaxy clustering**)

GALAXY CLUSTERS

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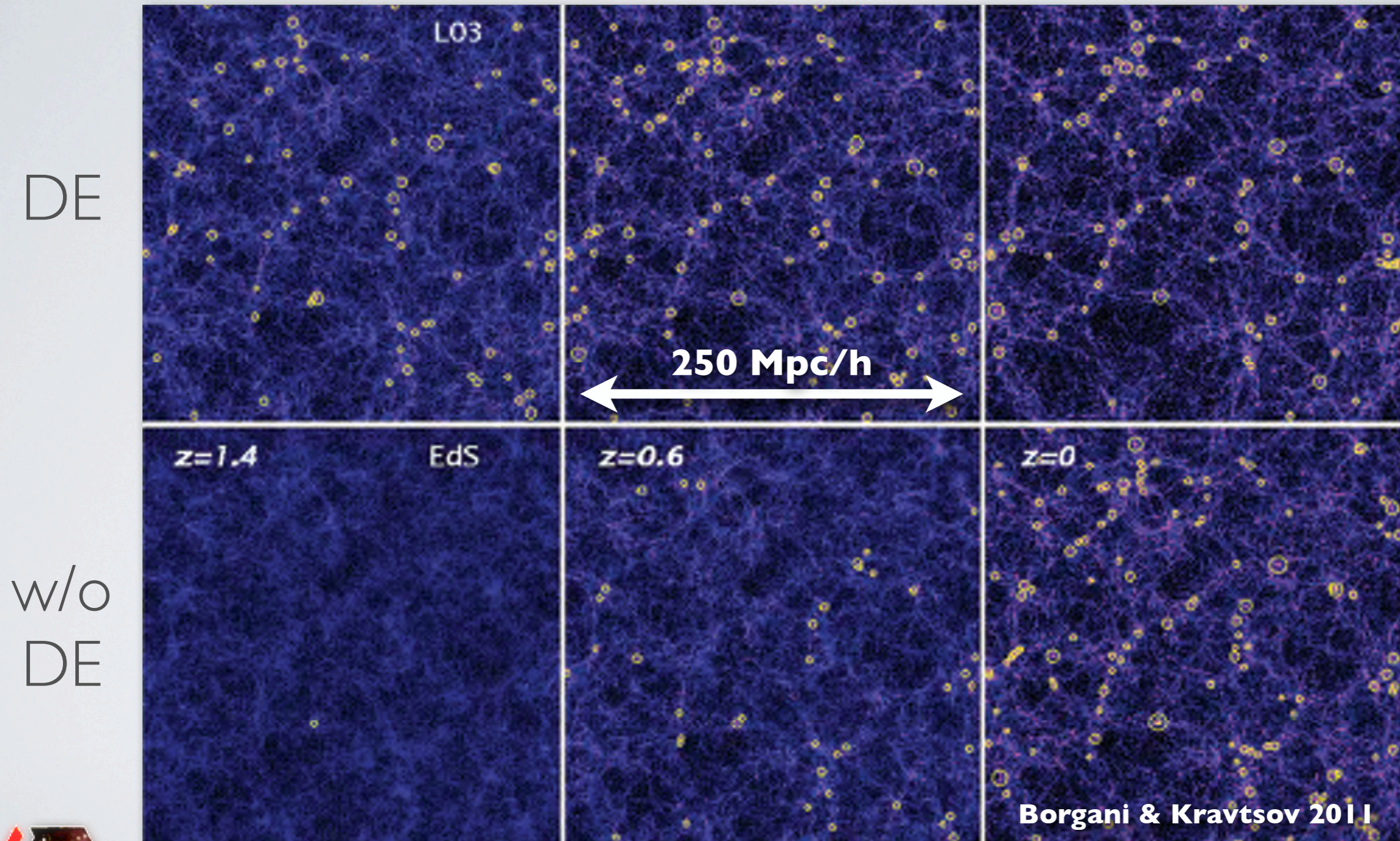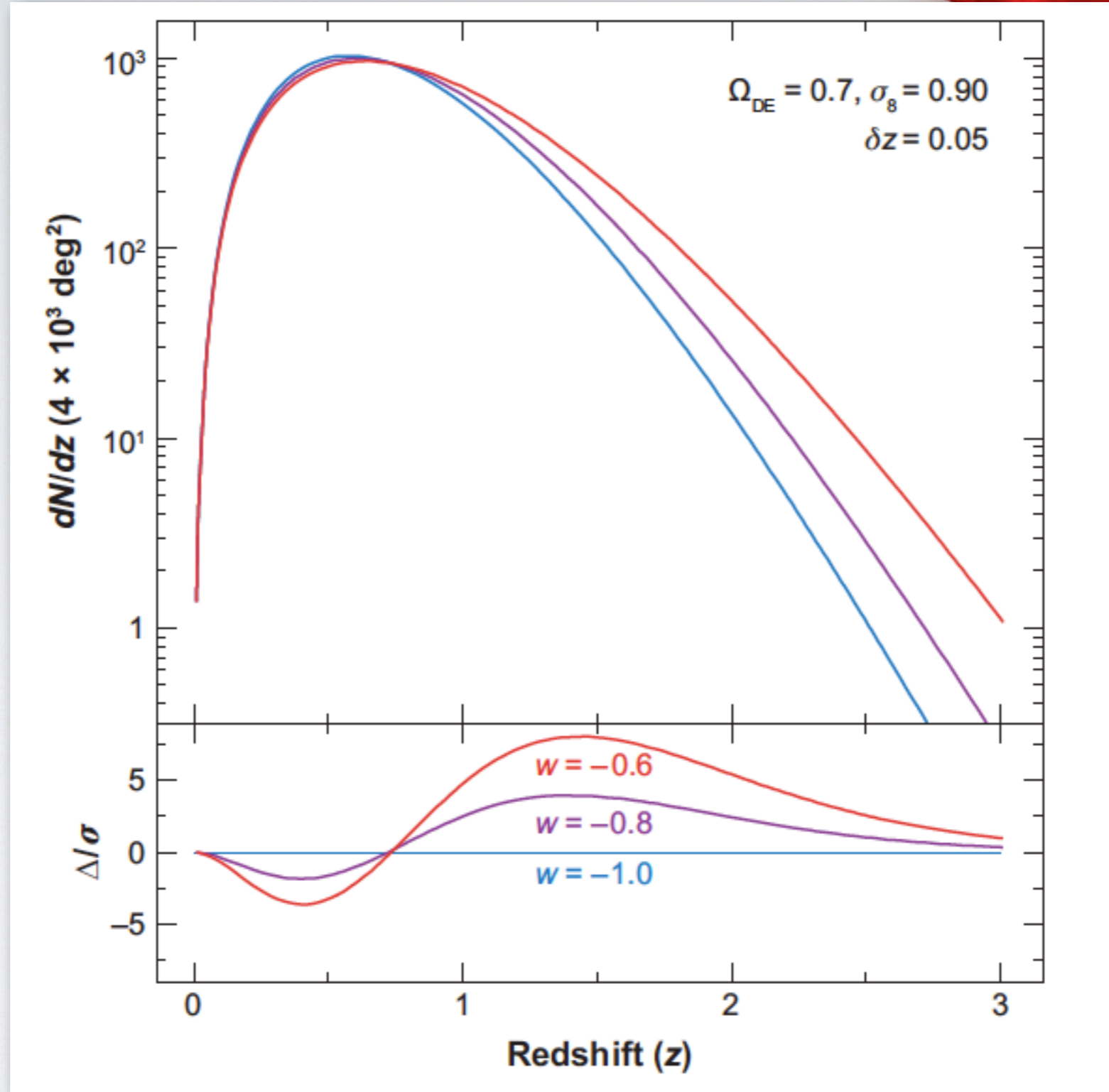**~20% hot diffuse gas**
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DES image

Cluster number density as a function of mass and redshift is very sensitive to cosmology.

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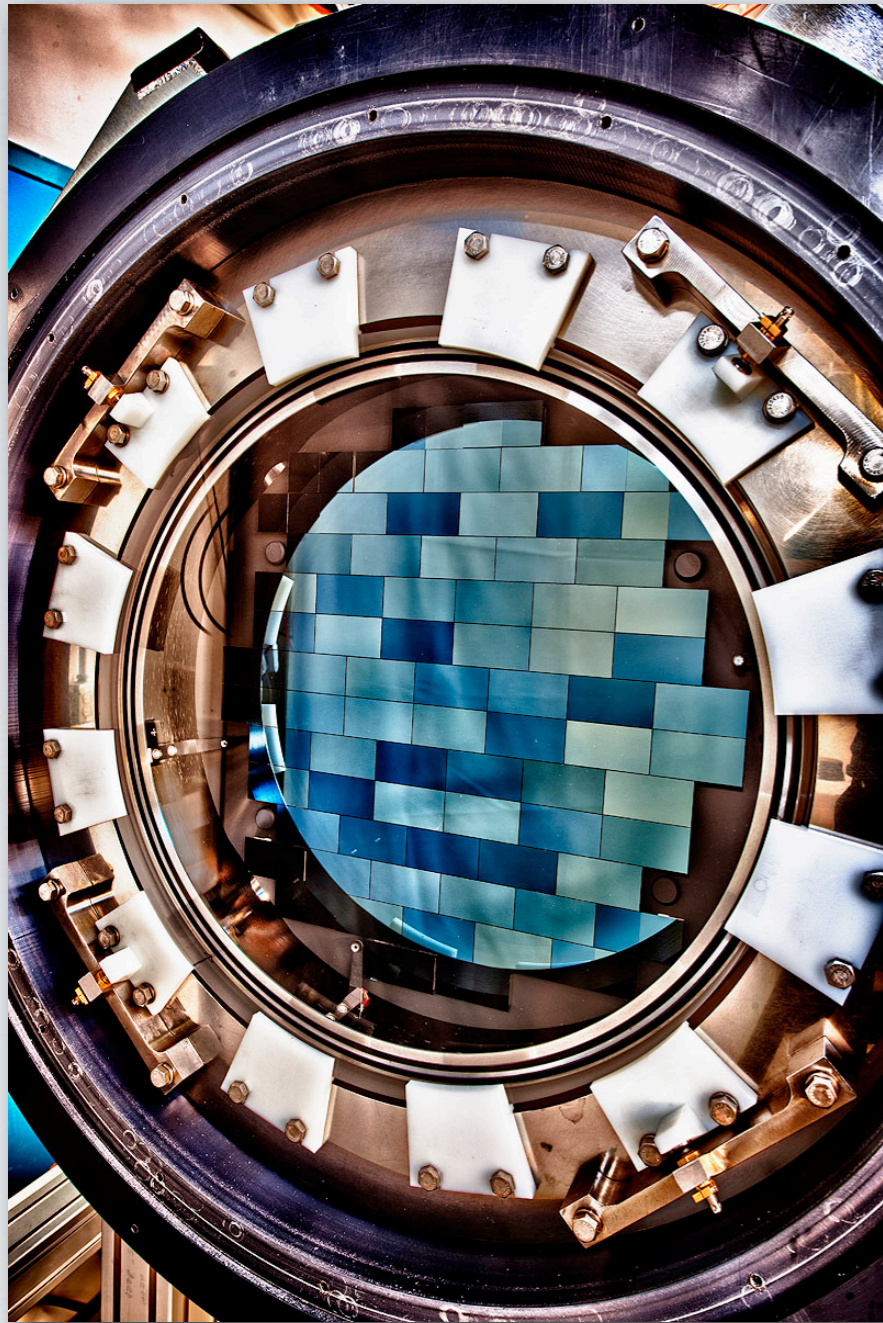— growth of structure (**galaxy clustering**)

EVOLUTION OF LARGE SCALE STRUCTURE

DE

w/o
DE

LO3

250 Mpc/h

z=1.4   EdS   z=0.6   z=0

Borgani & Kravtsov 2011

NUMBER COUNTS

DARK ENERGY SURVEY

DEcam

3 deg^2 FOV **570 Mpix** optical CCD camera

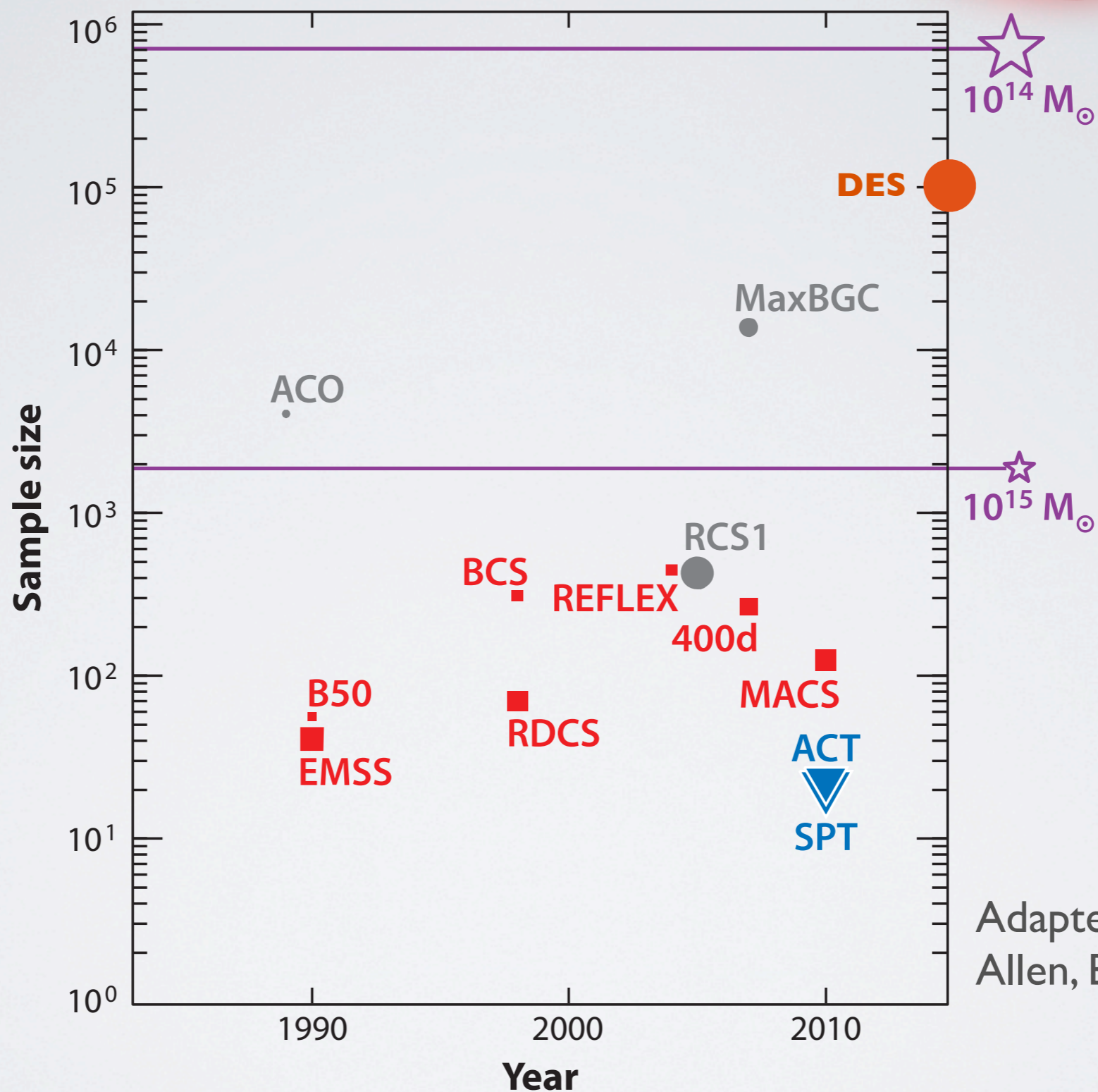Facility instrument at **CTIO Blanco 4-m telescope in Chile**

First light: Sep 2012

DES

5000 sq deg grizY
24th mag, 0.9'' seeing
525 nights: 2013-2018

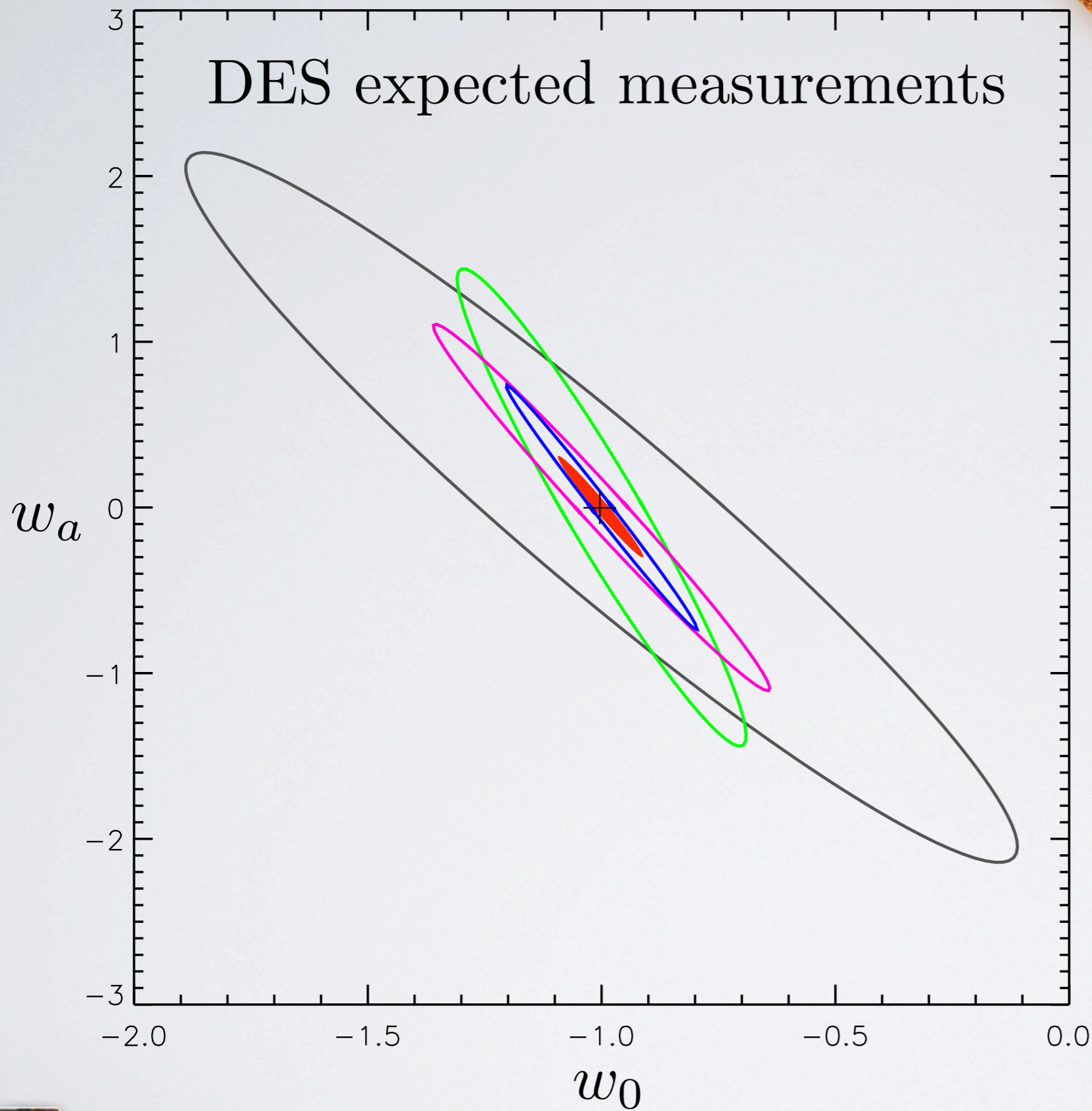**100,000 clusters
up to z~1
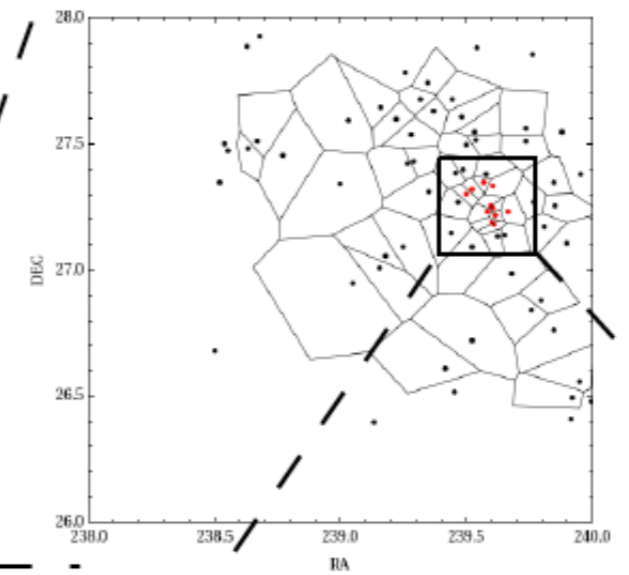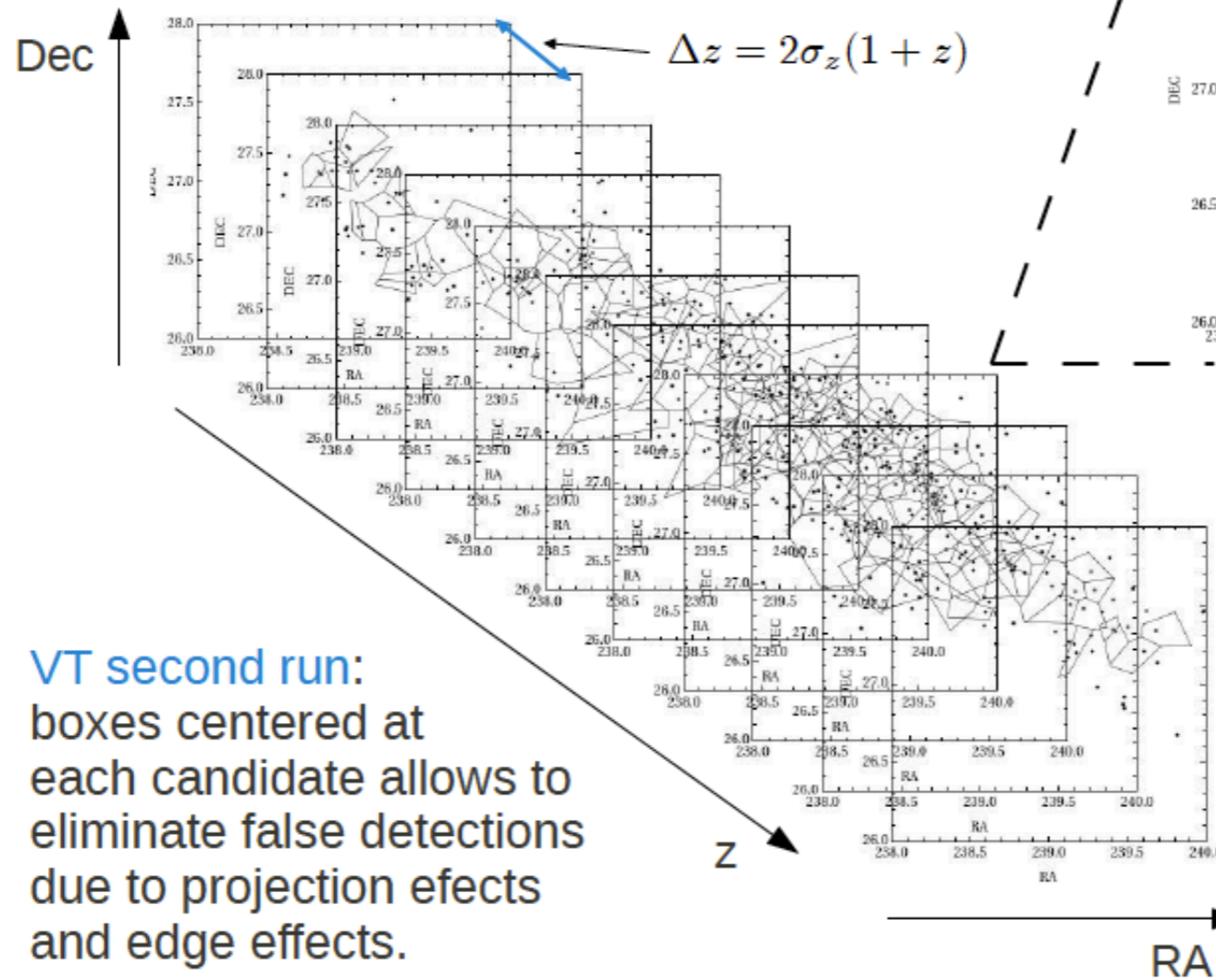down to ~$10^{13.5}$ M$_{sun}$**

CLUSTER SAMPLES

DES expected measurements

BAO
SNe
Clusters
WL
Combined

VT cluster finder in 2+1D

VT first run: cluster candidates detected in photo-z shells

$$\Delta z = 2\sigma_z(1 + z)$$

Dec

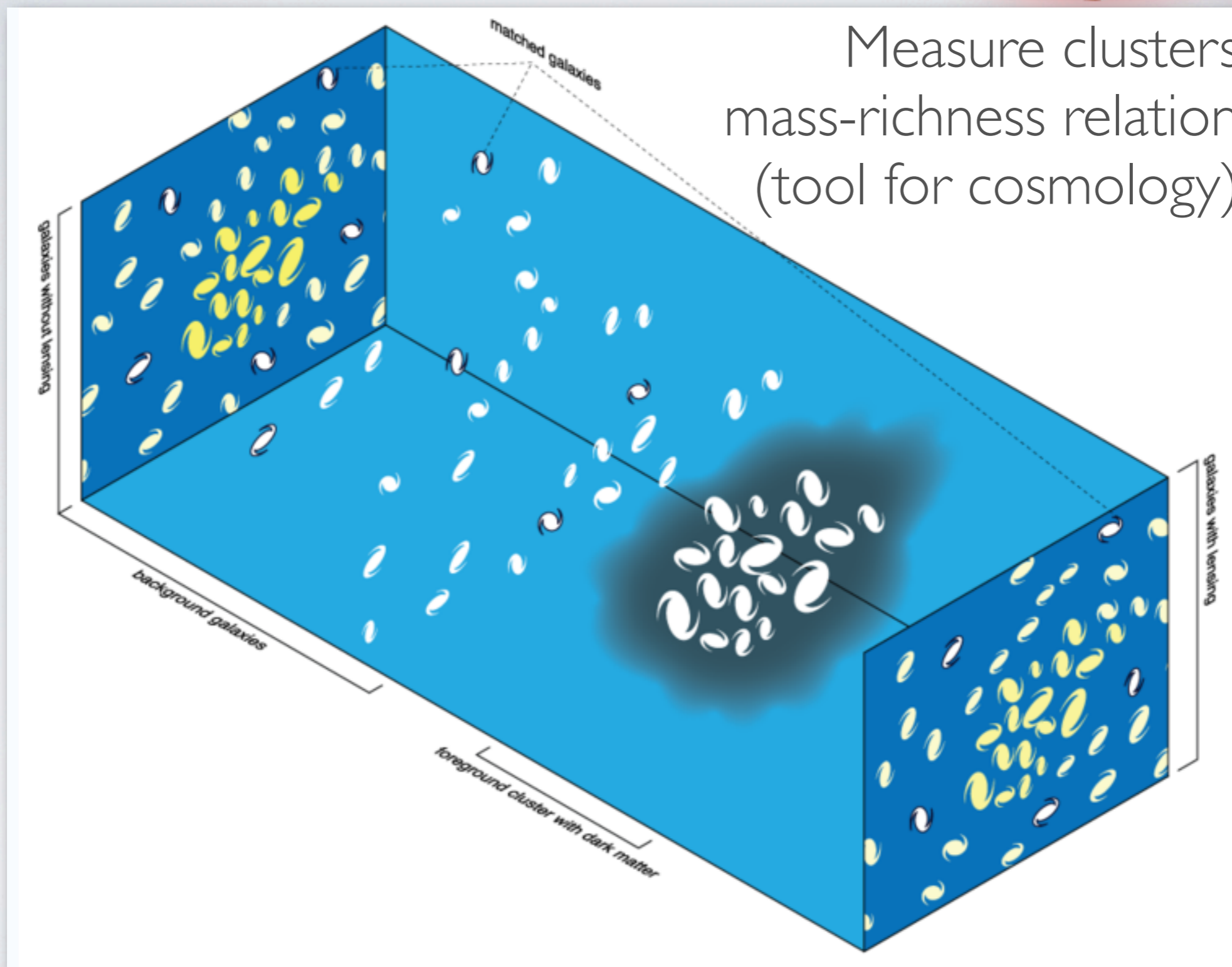**VT second run**: boxes centered at each candidate allows to eliminate false detections due to projection efects and edge effects.
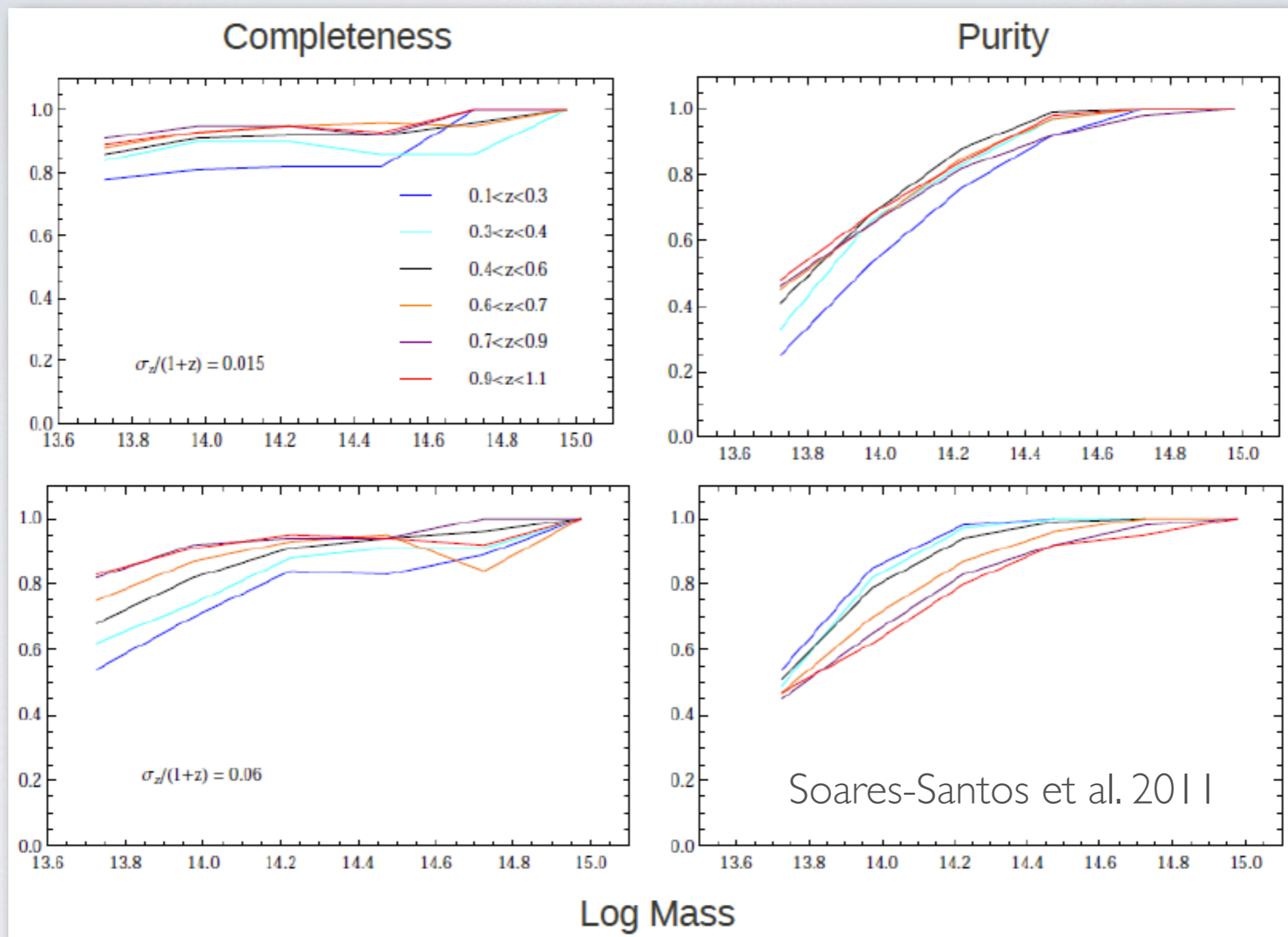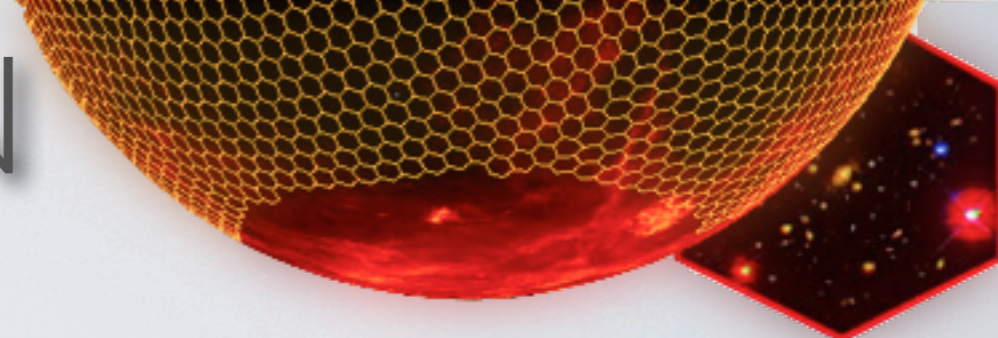
z

RA

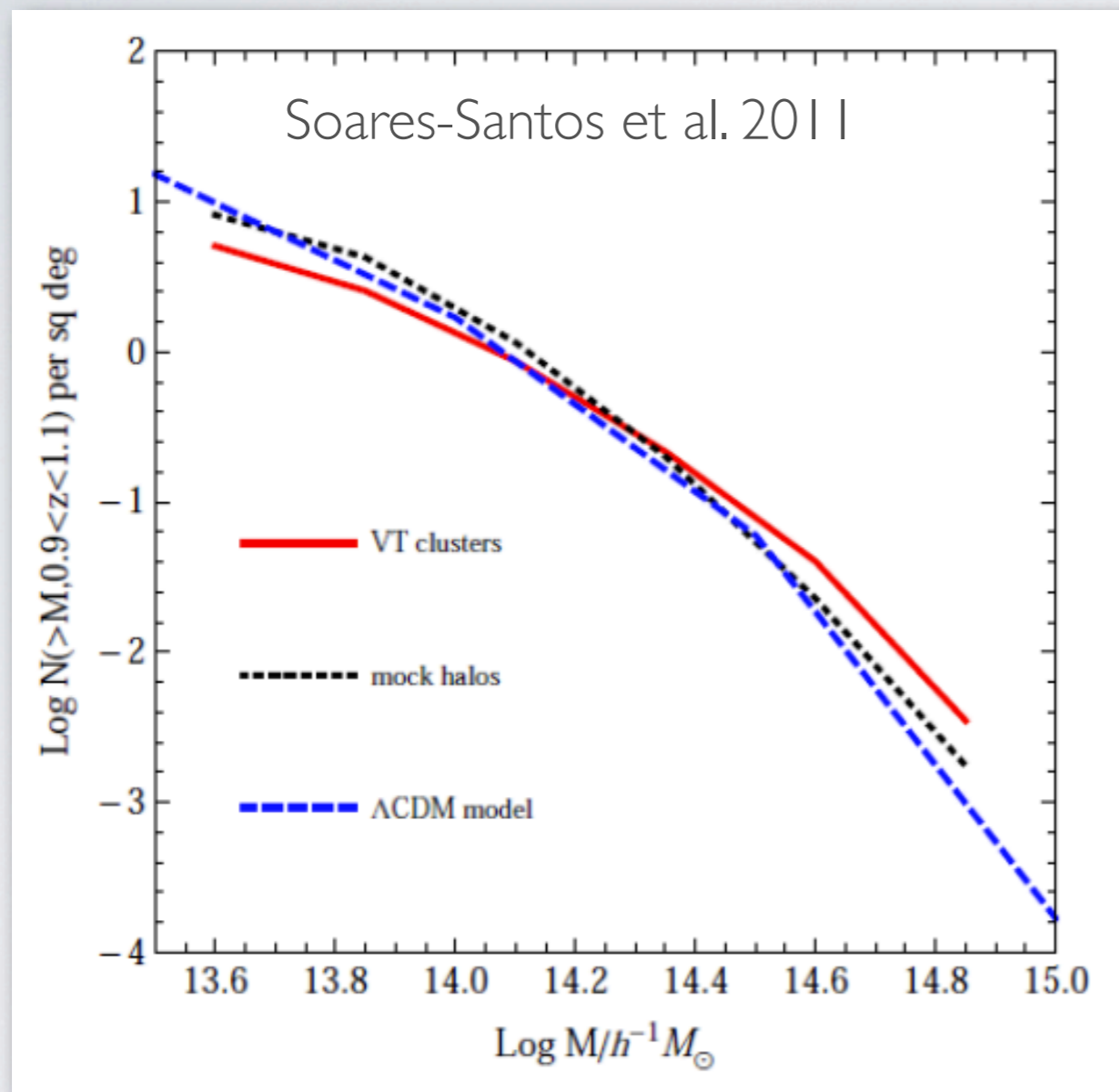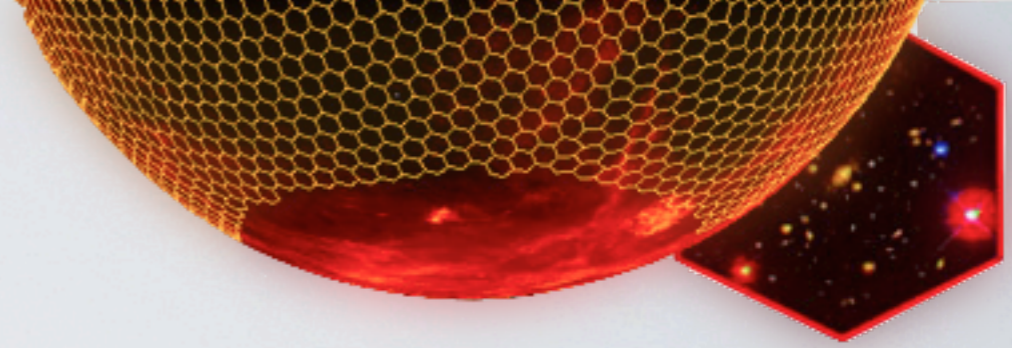NSCJ155821+271549 (z = 0.13)
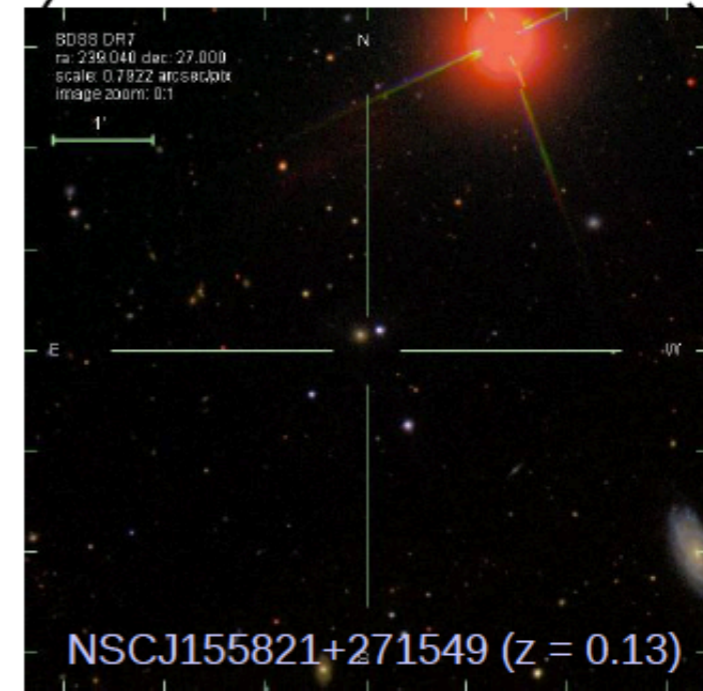
CLUSTER LENSING

Measure clusters mass-richness relation (tool for cosmology)

CLUSTER SELECTION FUNCTION

Completeness

Purity

$\sigma_z/(1+z) = 0.015$

0.1<z<0.3
0.3<z<0.4
0.4<z<0.6
0.6<z<0.7
0.7<z<0.9
0.9<z<1.1

$\sigma_z/(1+z) = 0.06$

Soares-Santos et al. 2011

Log Mass

CLUSTER MASS FUNCTION

Soares-Santos et al. 2011

VT clusters
mock halos
ΛCDM model
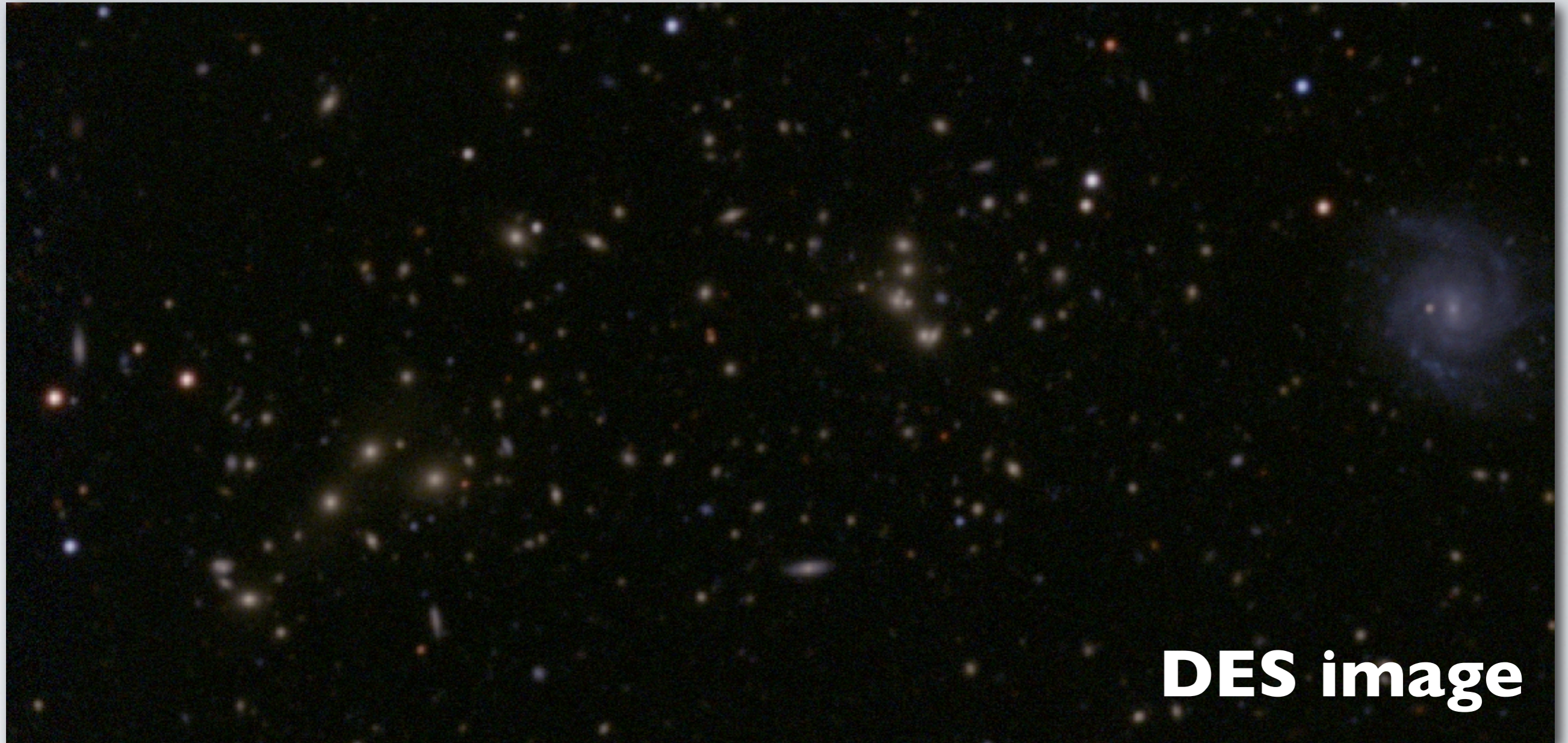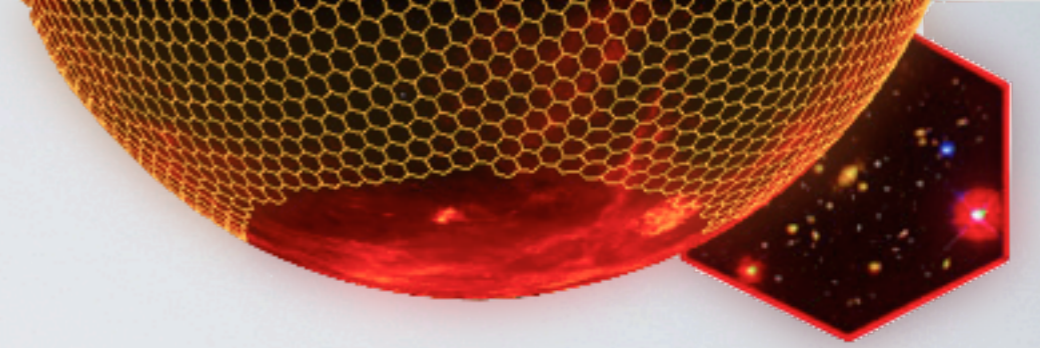
By applying the VT cluster finder on mock catalogs, we can measure the selection function for our cluster catalog.
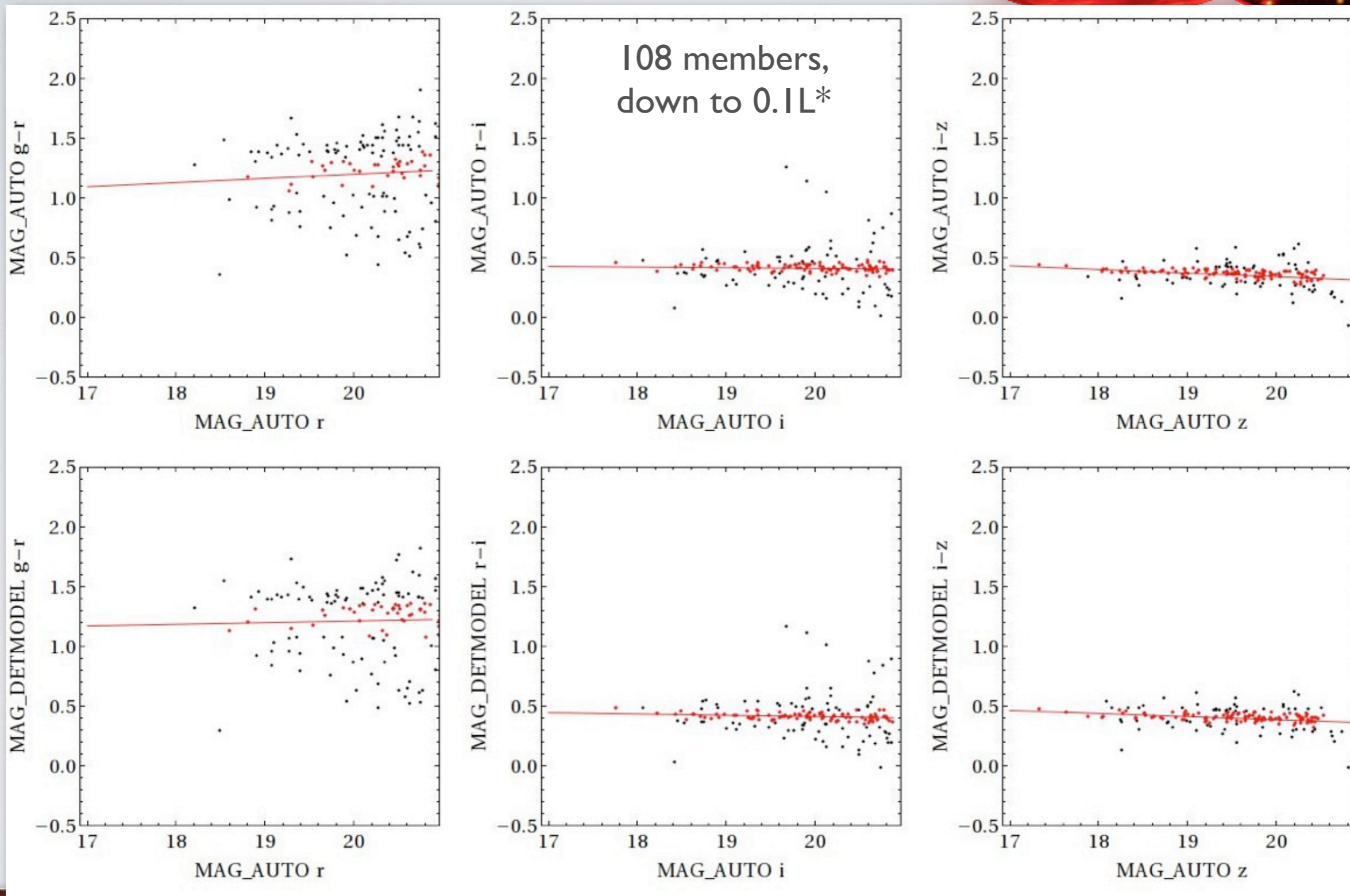
We apply that selection function back to the cluster number counts to obtain the mass function.

ABELL 142

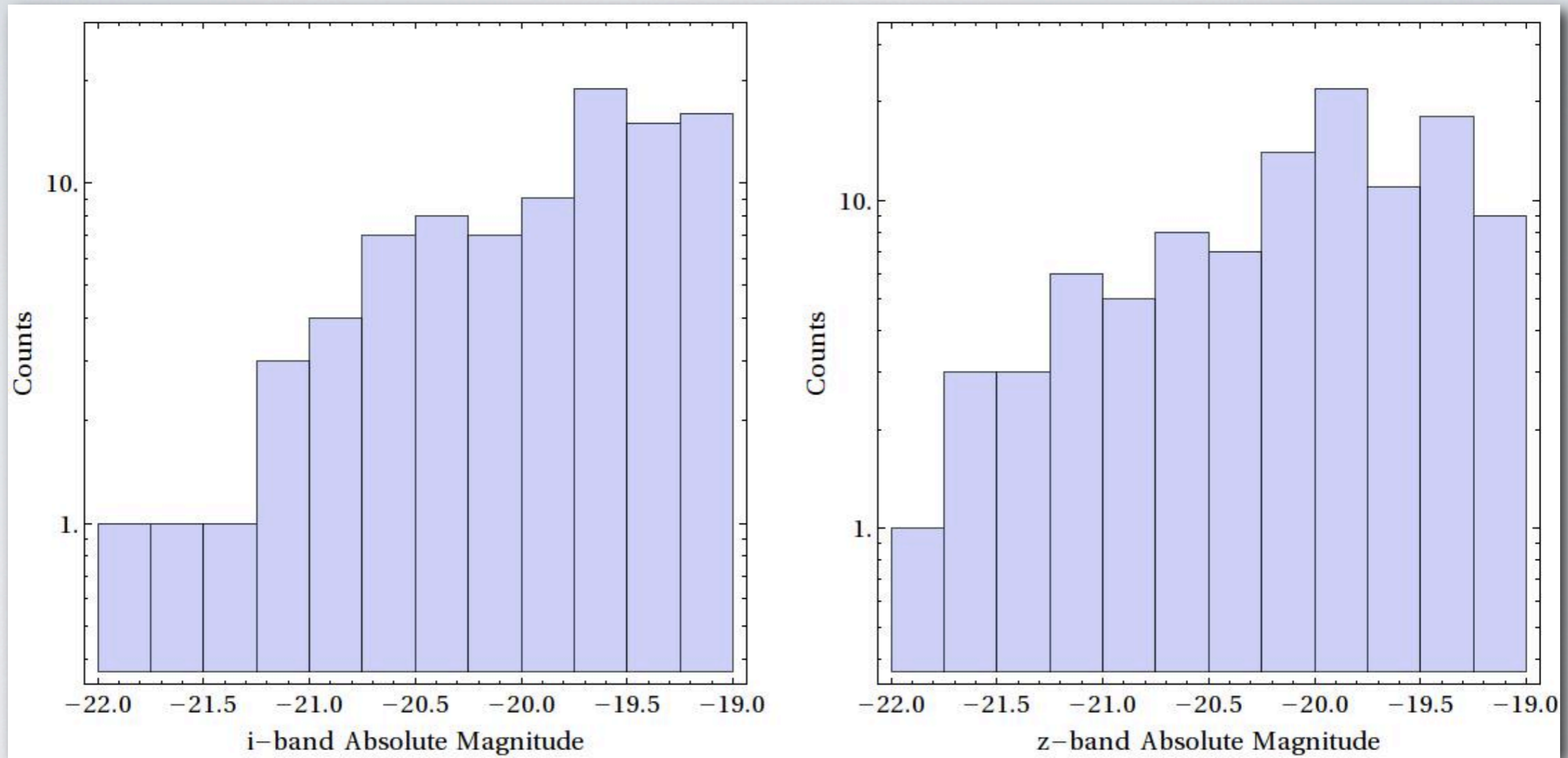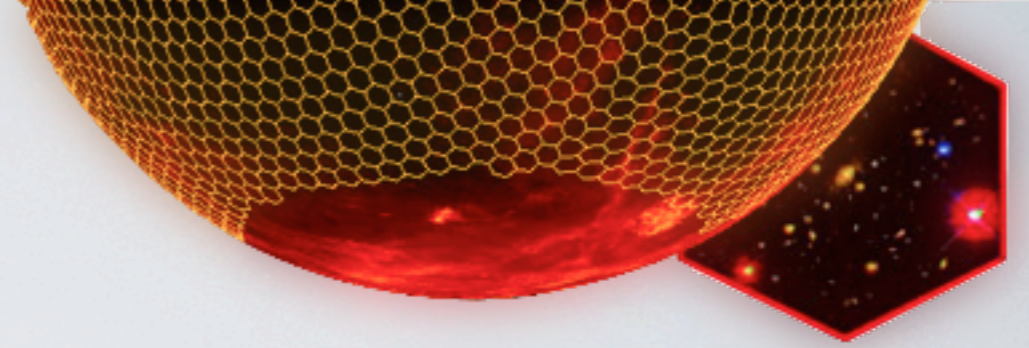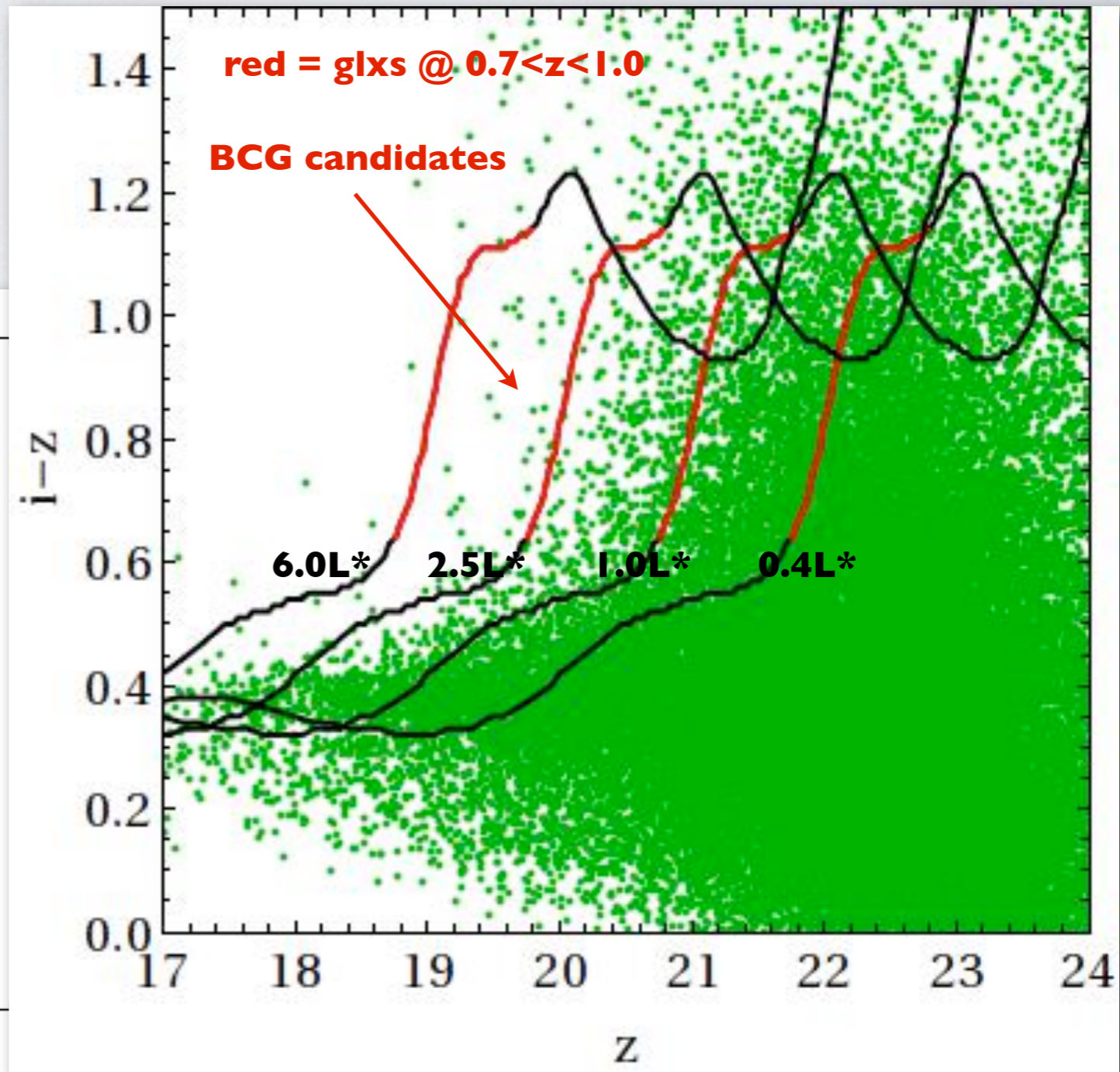**DES image**

108 members, down to 0.1L*

A142 LUMINOSITY FUNCTION

HIGH-Z CLUSTERS?

red = glxs @ 0.7<z<1.0

BCG candidates

A142

peaks are cluster member candidates

SDSS-III DR9 redshift

6.0L*   2.5L*   1.0L*   0.4L*
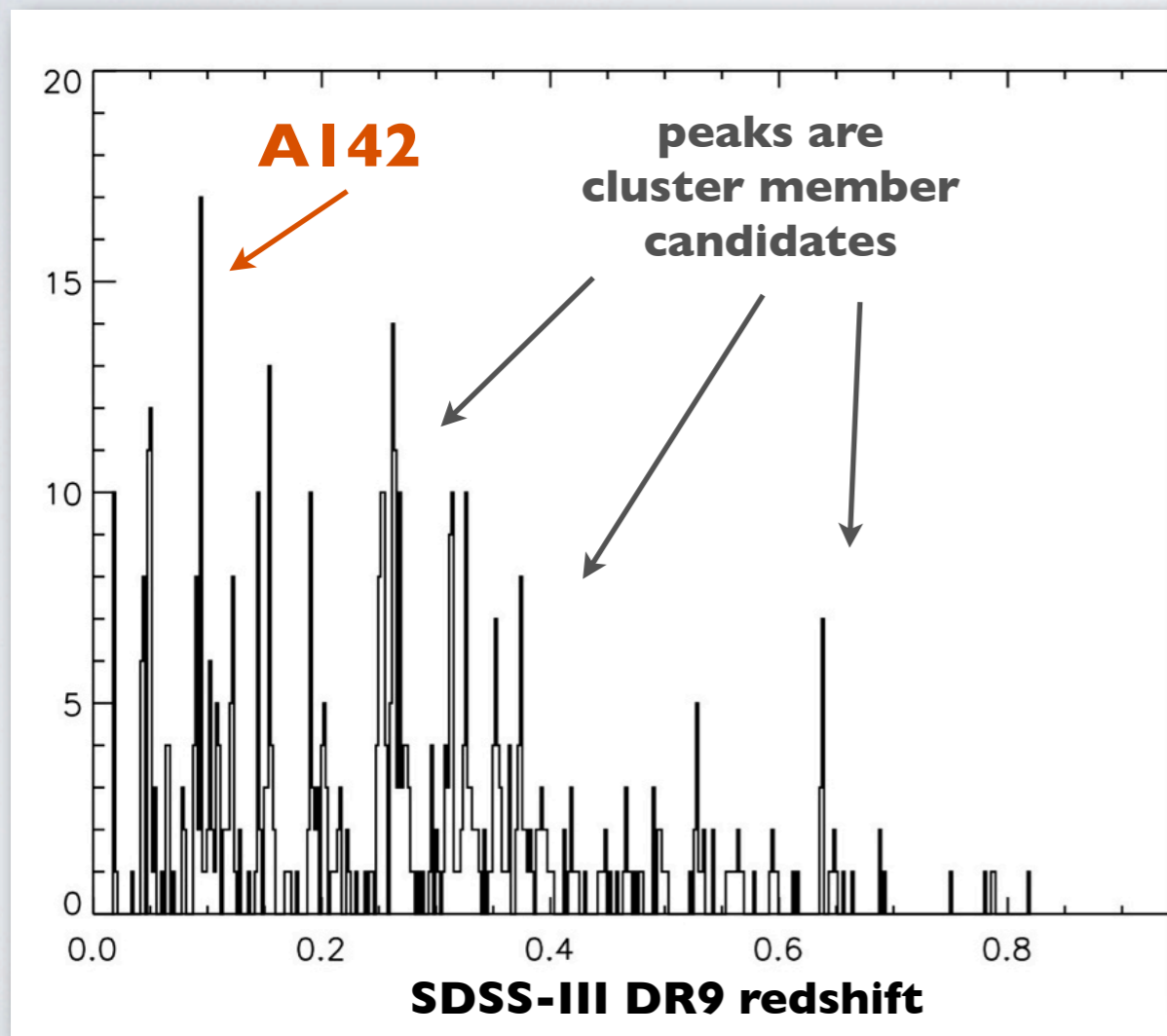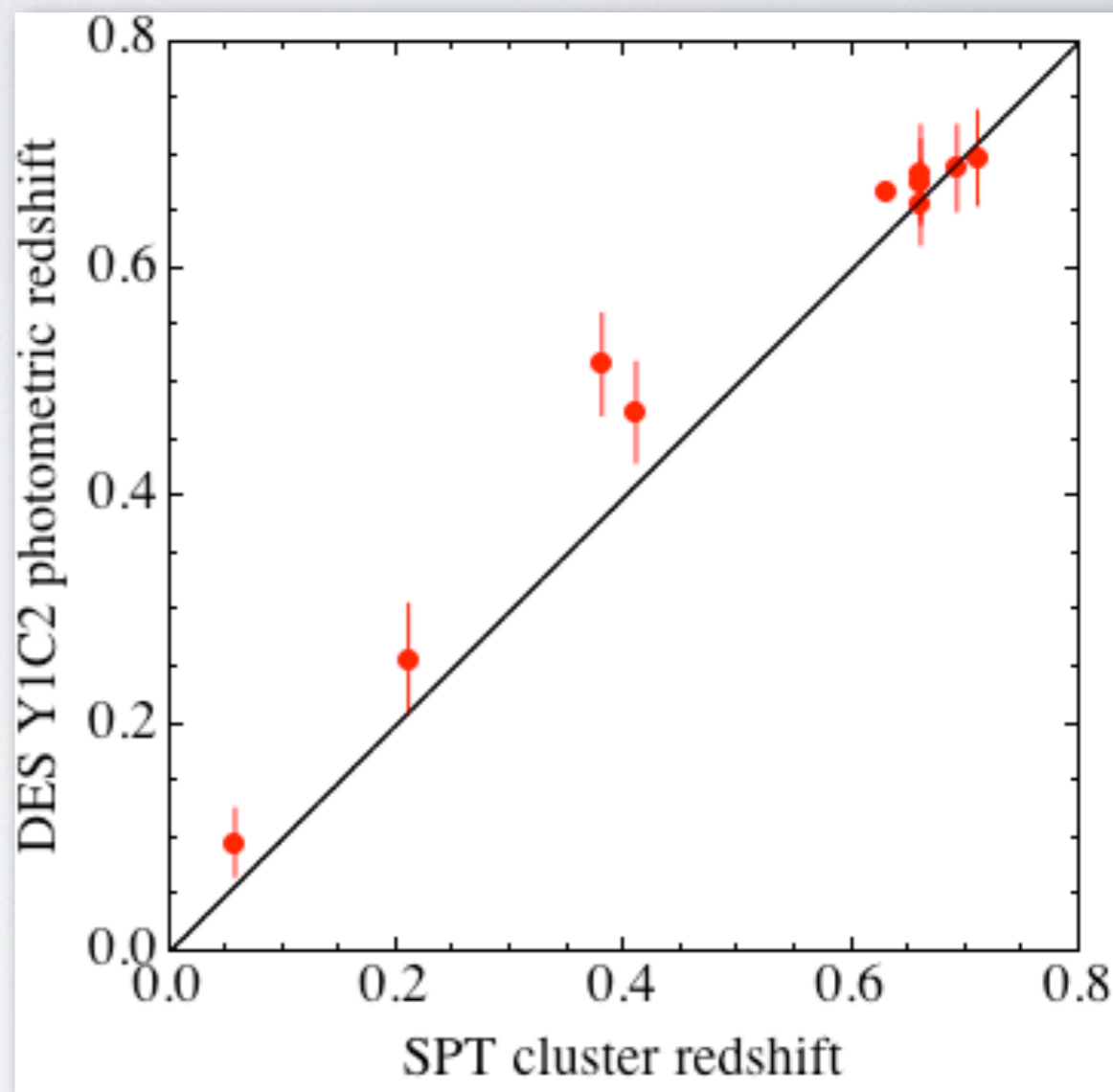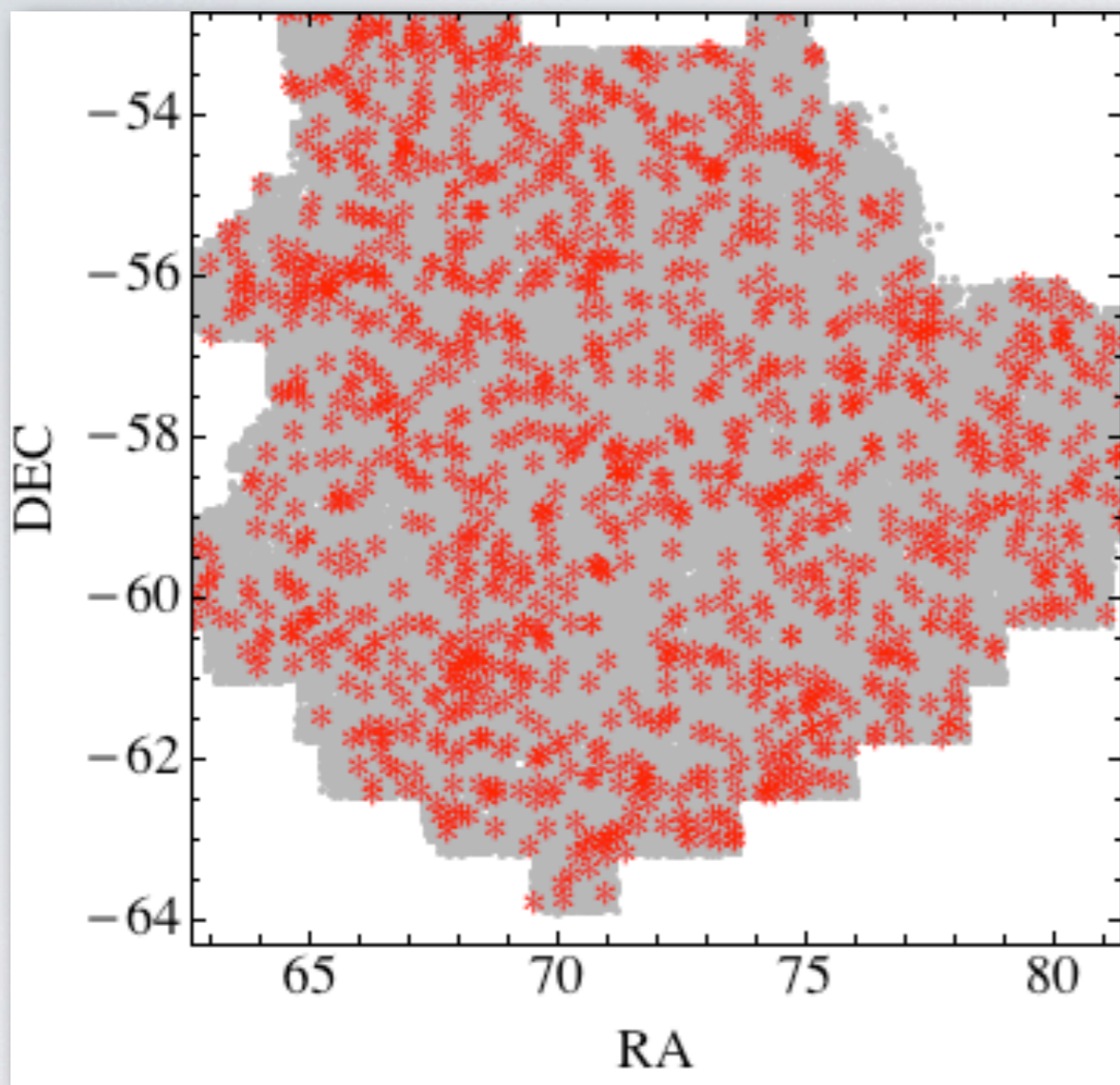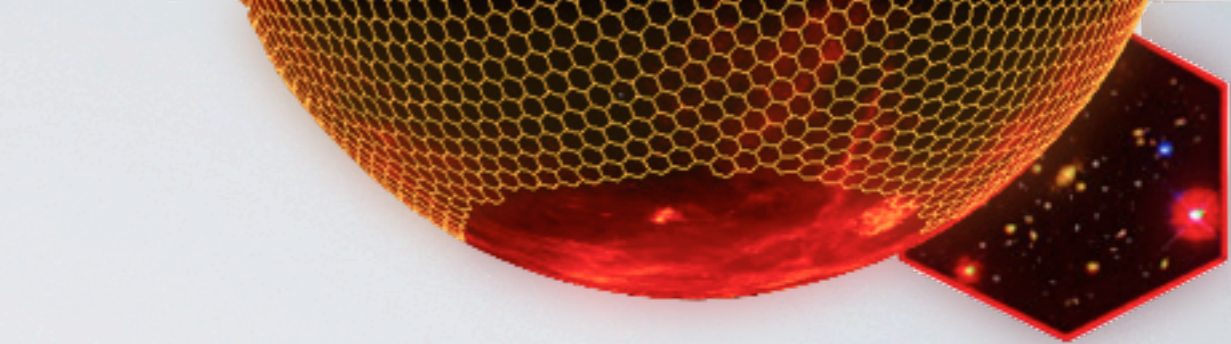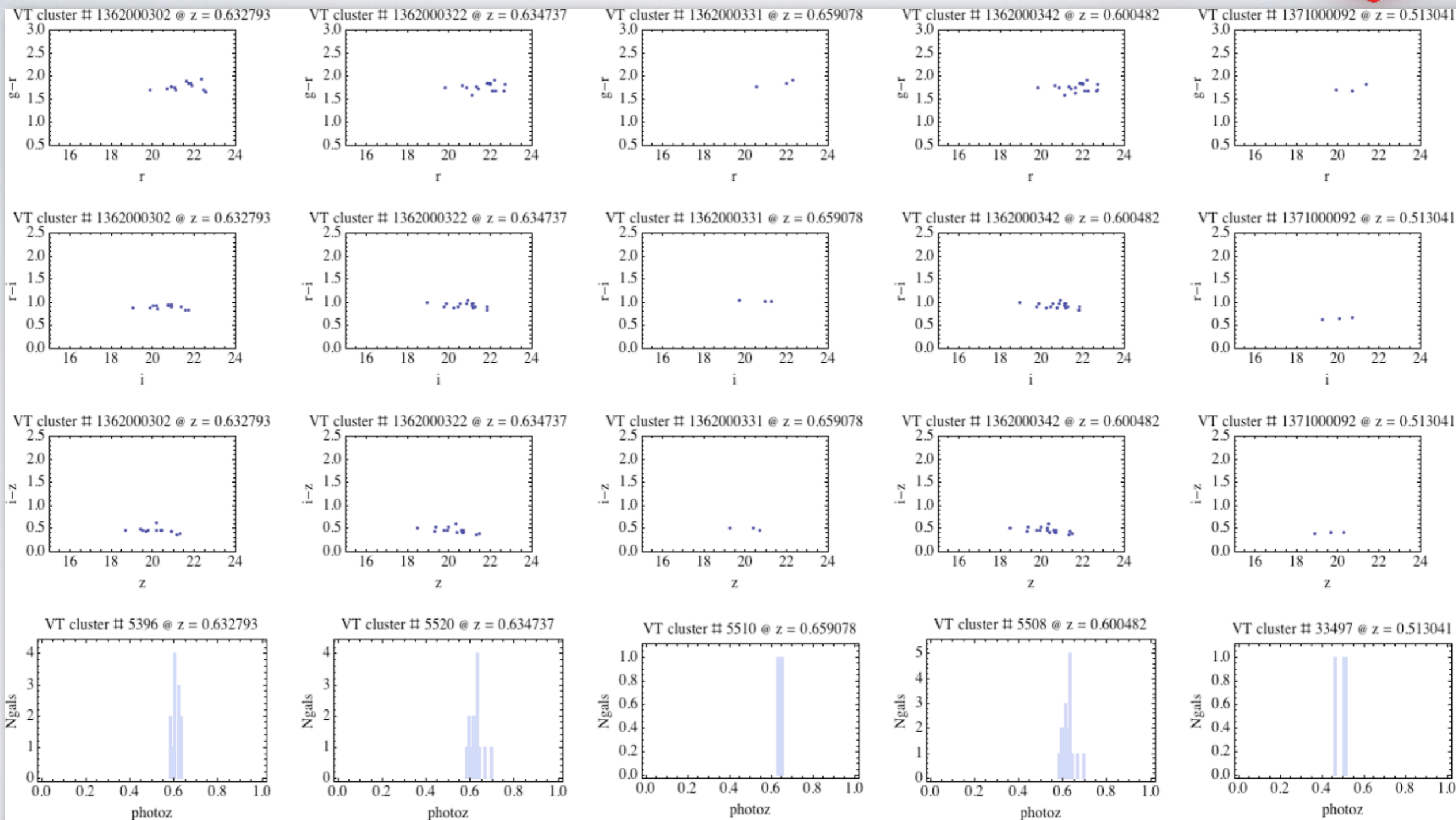
VT CLUSTERS

VT CLUSTERS

CONCLUSIONS

With 100,000 detections, DES will have the largest sample of galaxy clusters ever used for Cosmology.

DES Science Verification data indicate that we are in the right path: recovering known clusters and finding new ones.

We will use DES clusters to shed light on dark energy with unprecedented precision.