Back at the Edge of the Universe

Sintra, Portugal, 15-19 March 2015

THE RELATION BETWEEN STELLAR MASS AND ENVIRONMENT AND THEIR ROLE IN SHAPING GALAXY PROPERTIES AT DIFFERENT REDSHIFTS

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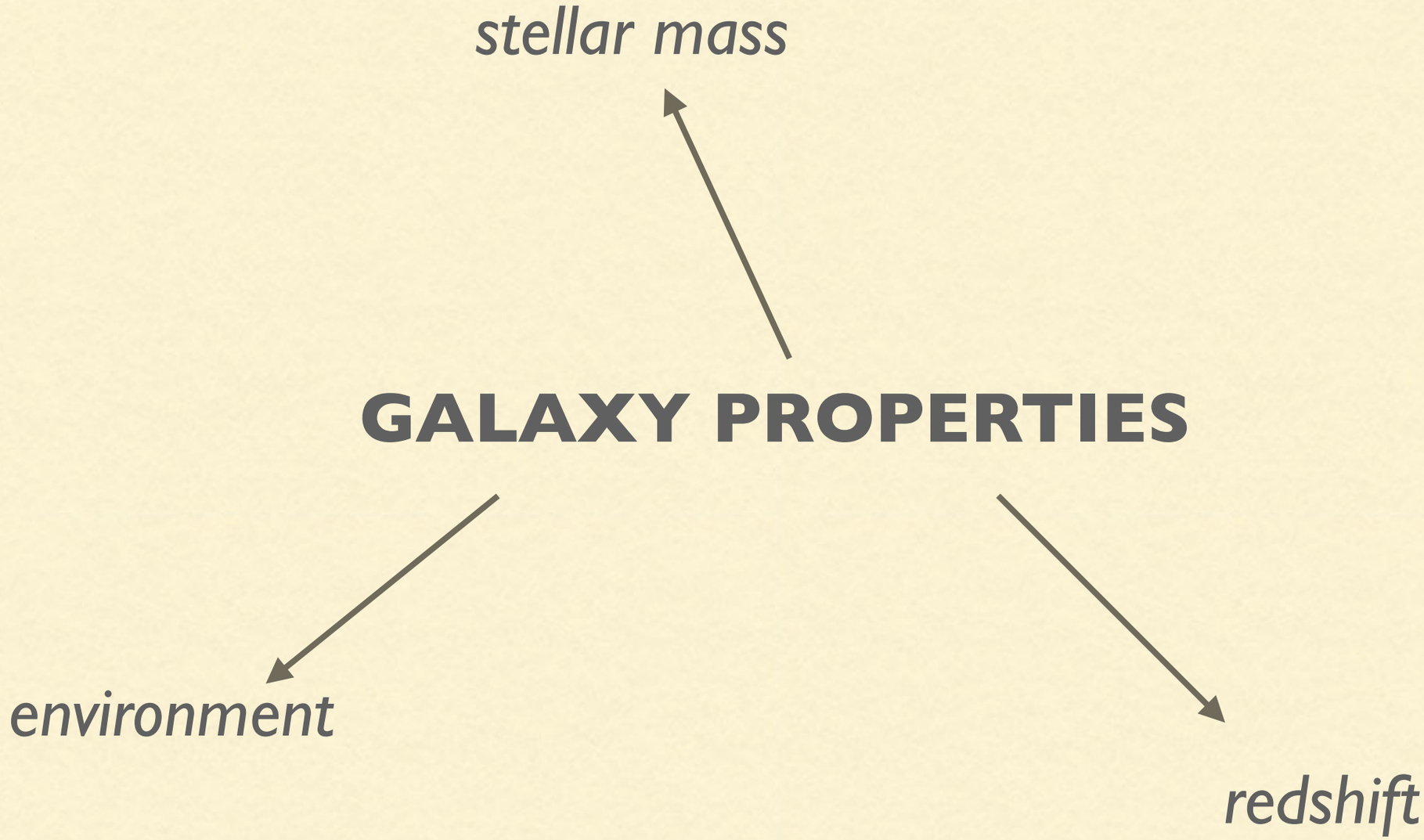
in collaboration with: B. M. Poggianti, G. De Lucia, K. Bundy, S. More, R. Calvi

THE MAIN DRIVERS OF GALAXY EVOLUTION

GALAXY PROPERTIES

THE MAIN DRIVERS OF GALAXY EVOLUTION



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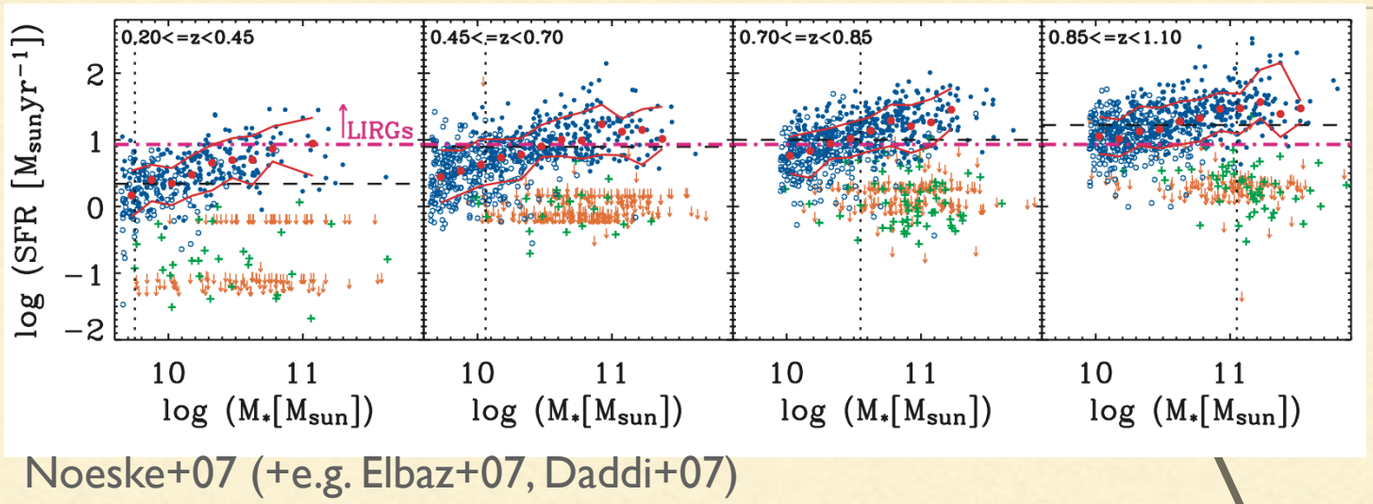
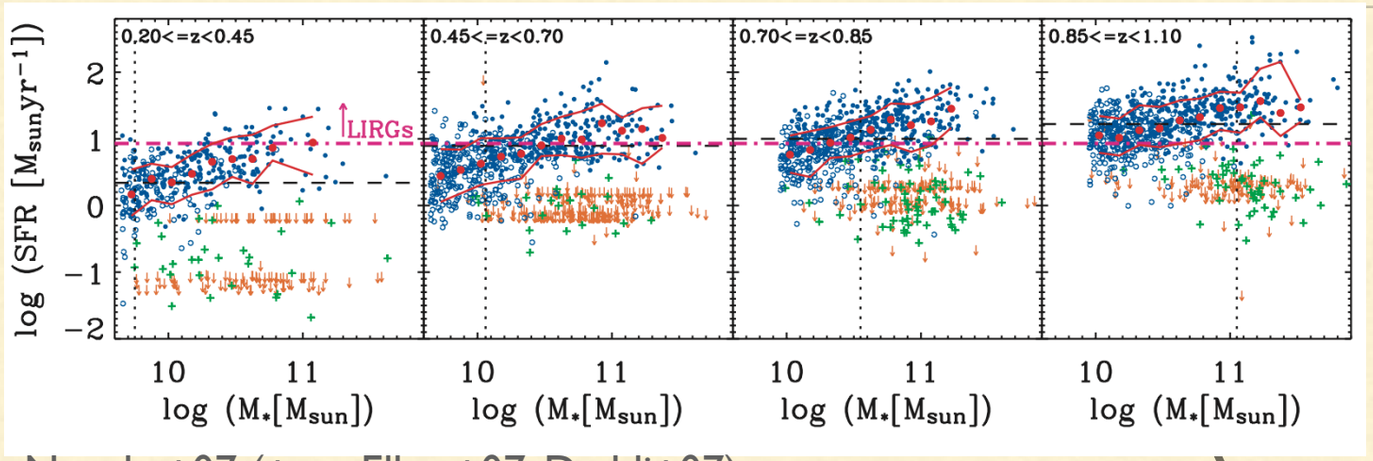


GALAXY PROPERTIES

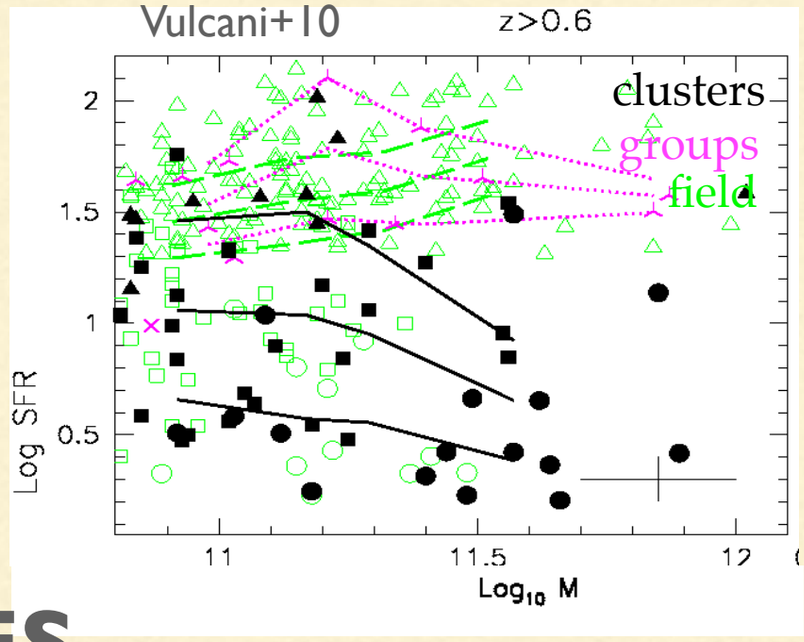
environment

redshift

THE MAIN DRIVERS OF GALAXY EVOLUTION



Noeske+07 (+e.g. Elbaz+07, Daddi+07)



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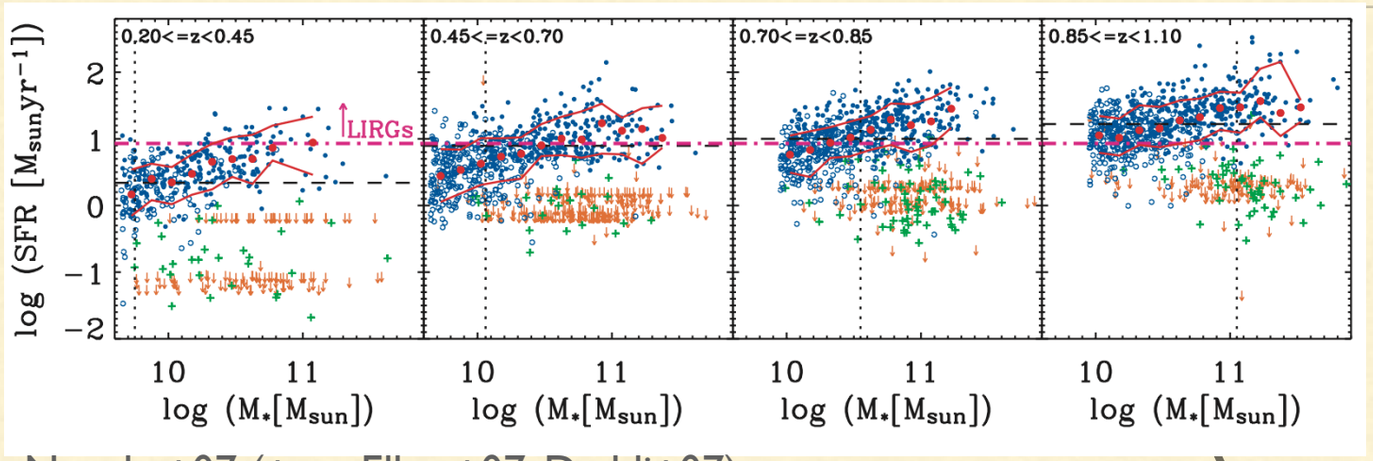

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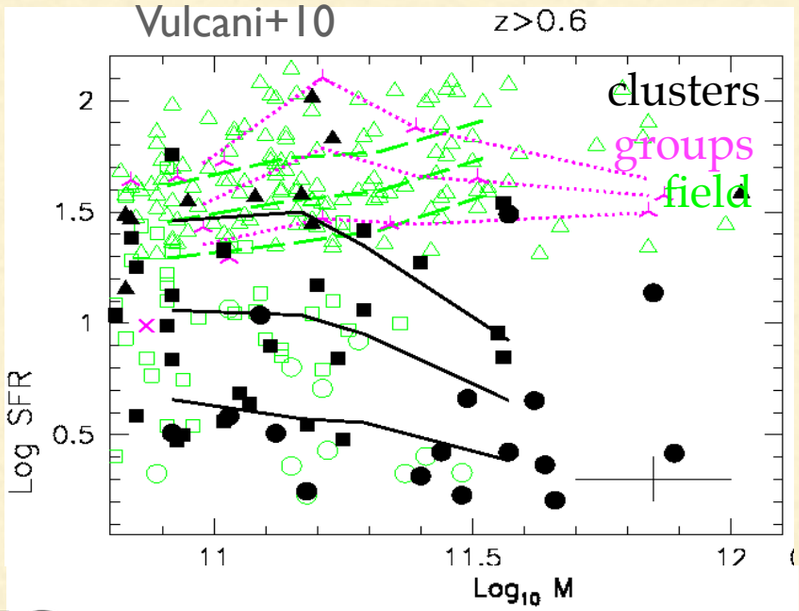
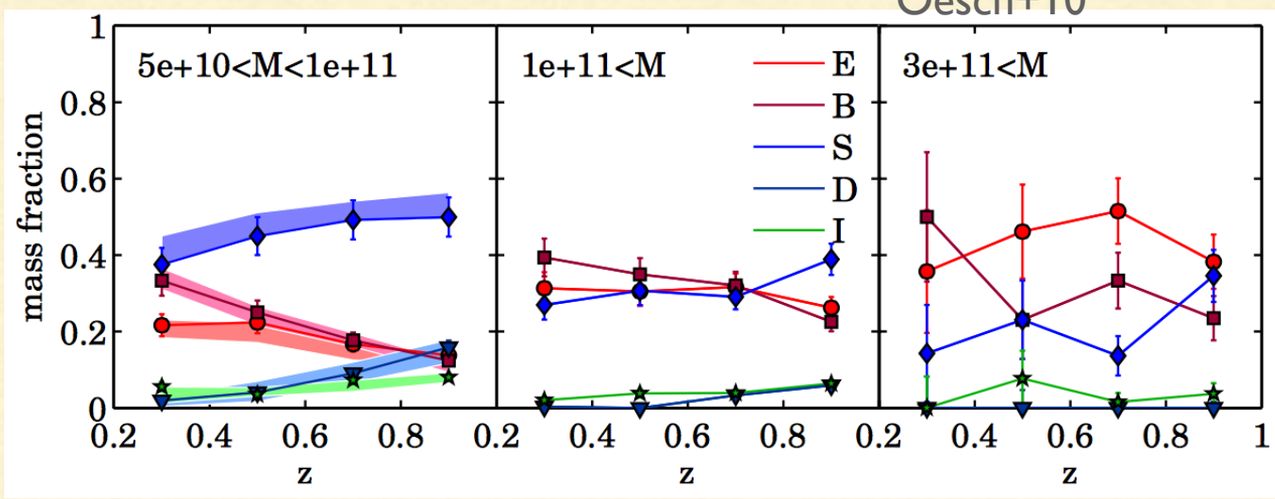


GALAXY PROPERTIES

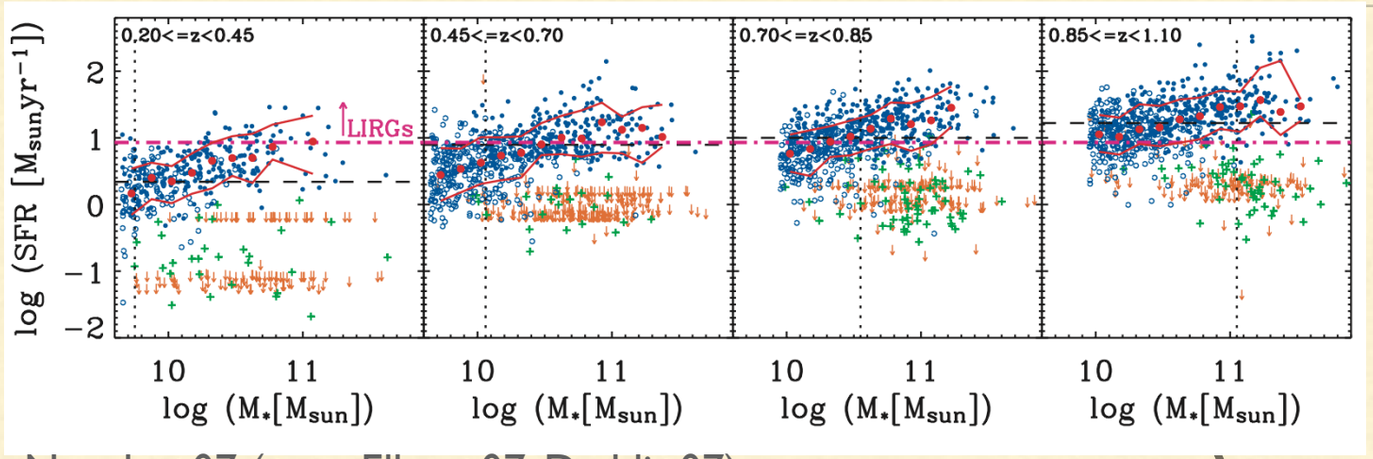
environment

Oesch+10



(+e.g. Dressler+97, Fasano +00, Postman+05, Desai+07)

THE MAIN DRIVERS OF GALAXY EVOLUTION



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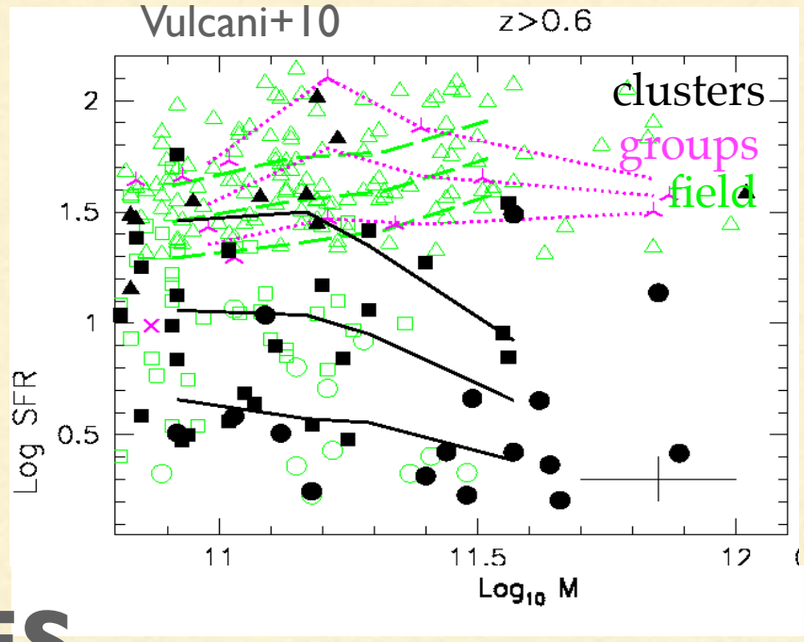
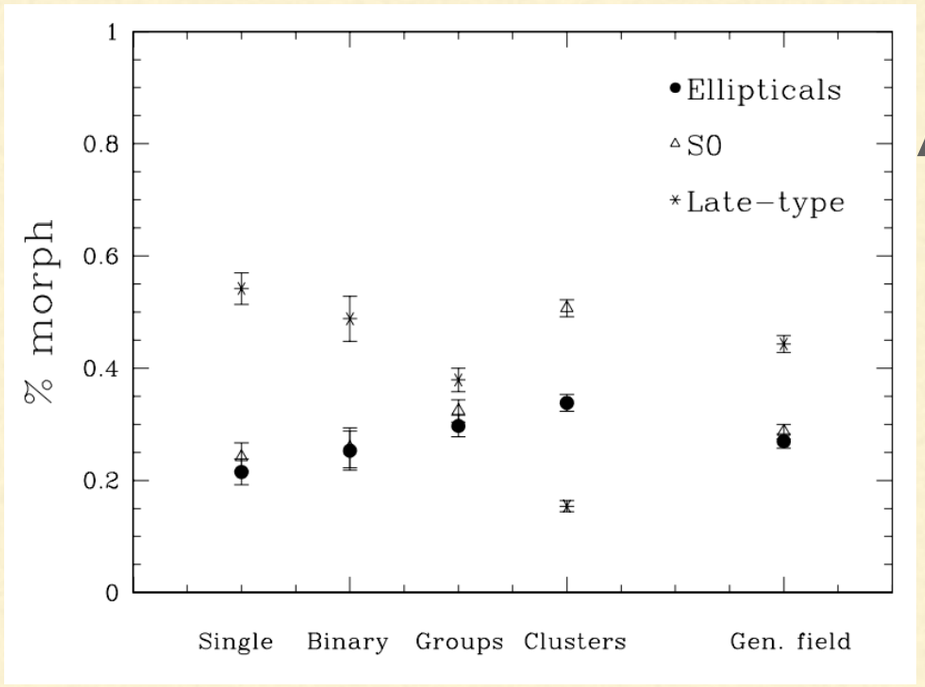
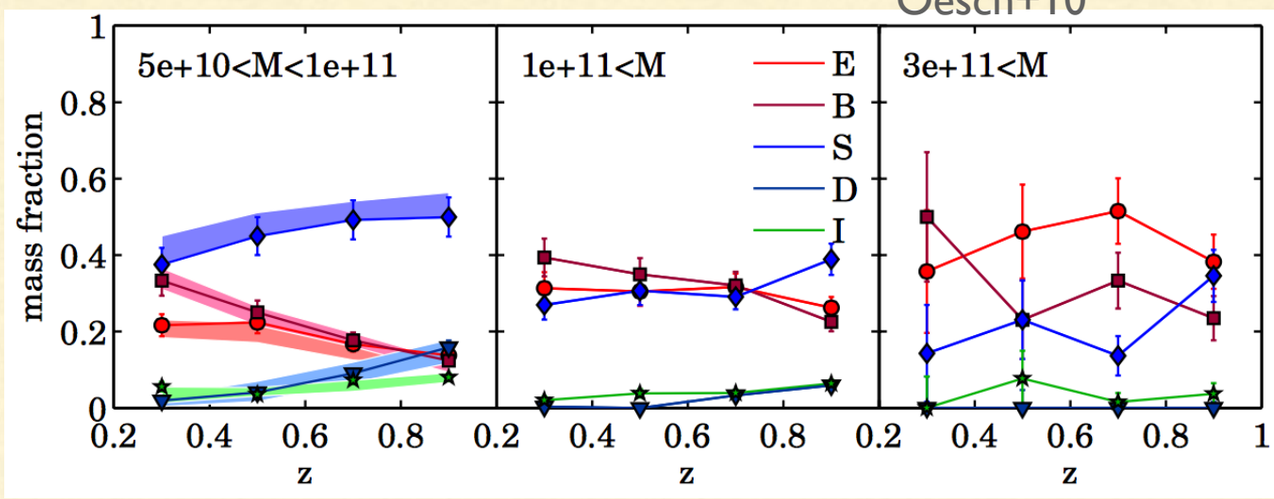


AXY PROPERTIES



Vulcani+11, Calvi+11



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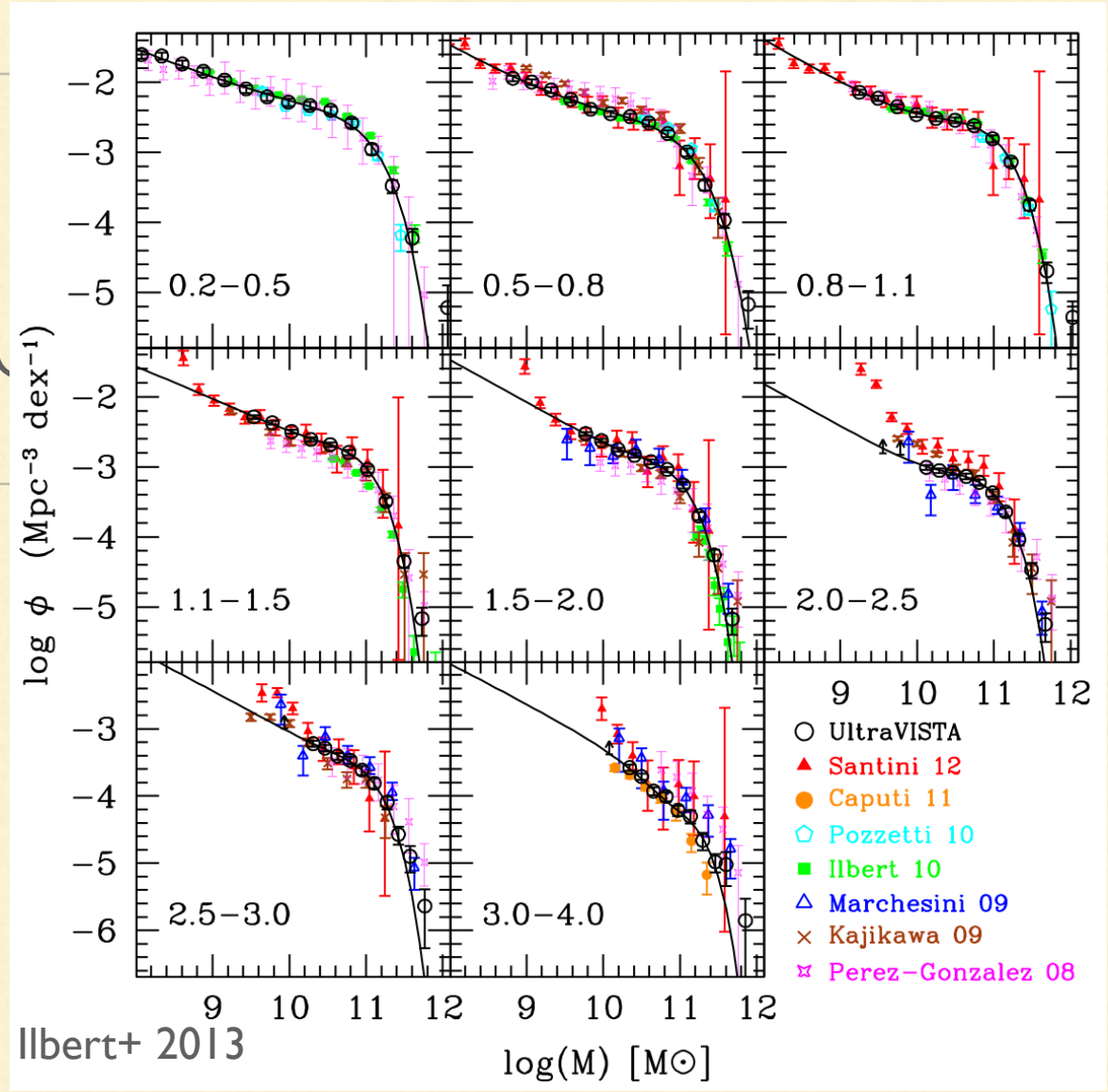
HOW ARE THE MASS AND THE ENVIRONMENT RELATED AT DIFFERENT REDSHIFTS?

THE GALAXY STELLAR MASS FUNCTION:
(SOME) OBSERVATIONAL RESULTS

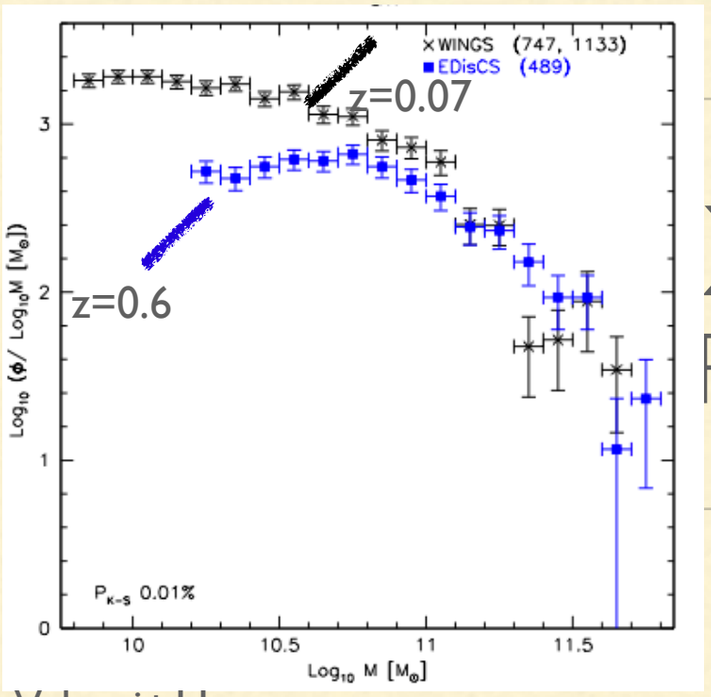
THE GALAXY STELLAR
(SOME) OBSERVATIONAL RESU



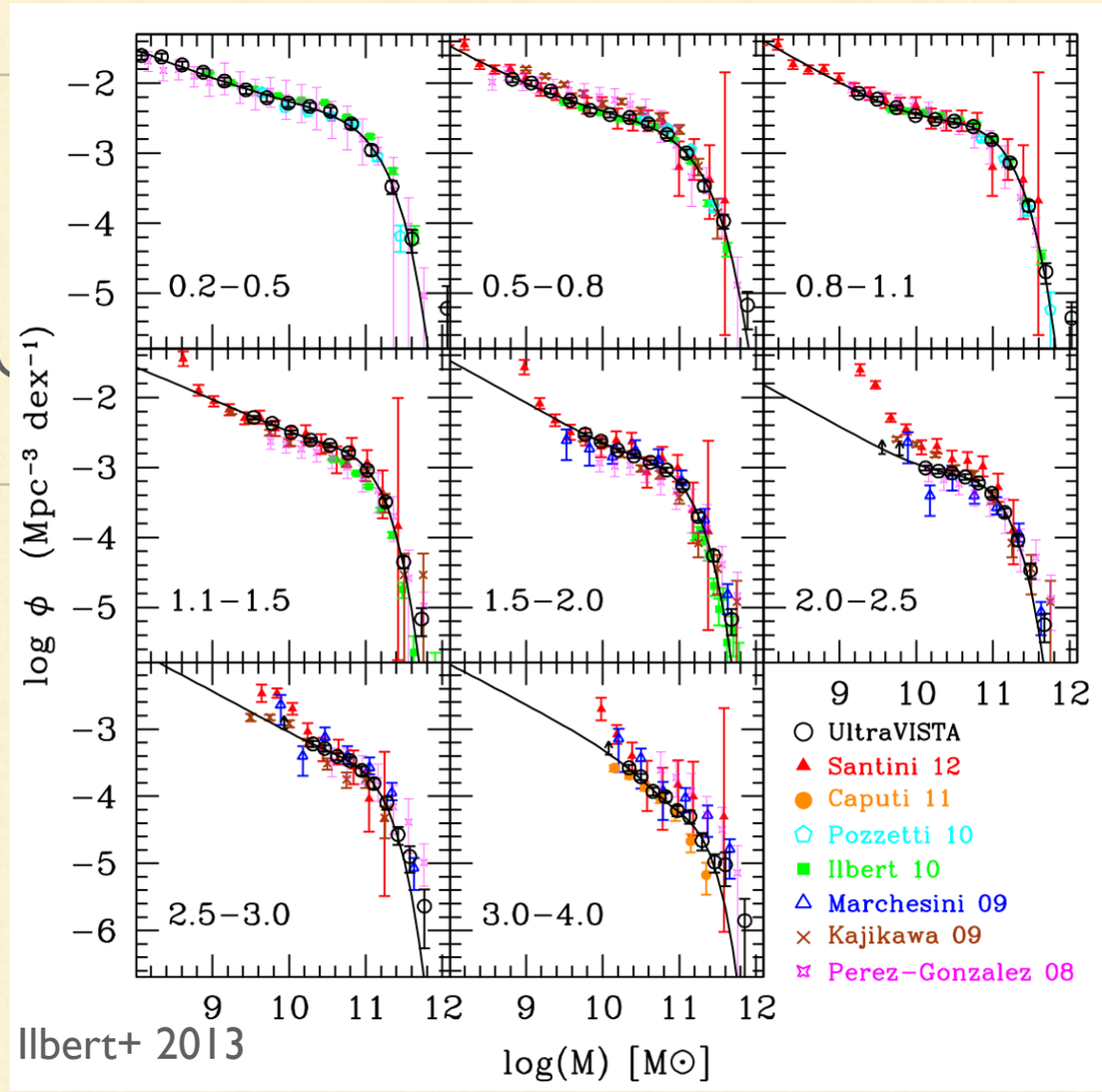
Ilbert+ 2013

(+ e.g. Fontana+06, Bundy+06, Franceschini+06, Borch+06, Vergani+08, Drory+09, Marchesini+09, Pozzetti+11, Mortlock+11, Muzzin+13,)

XY STELLAR
RVATIONAL RESU



Vulcani+11



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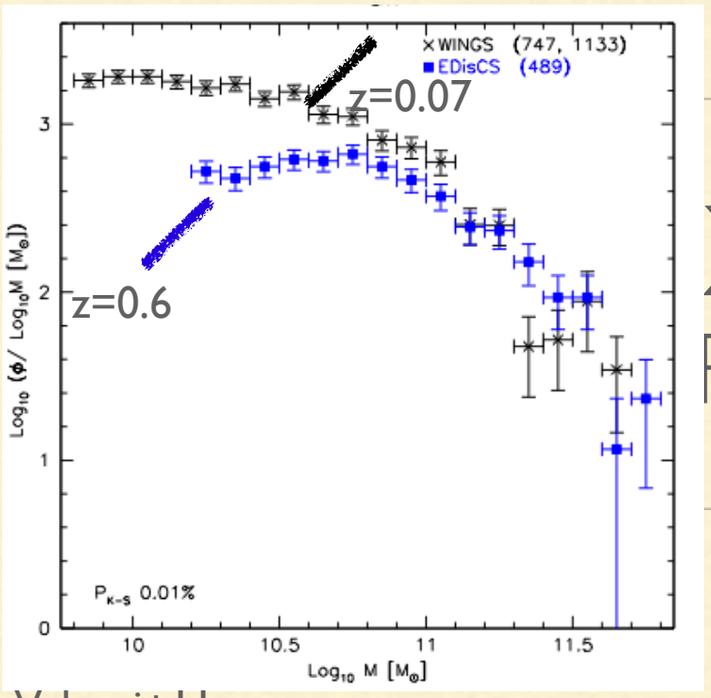
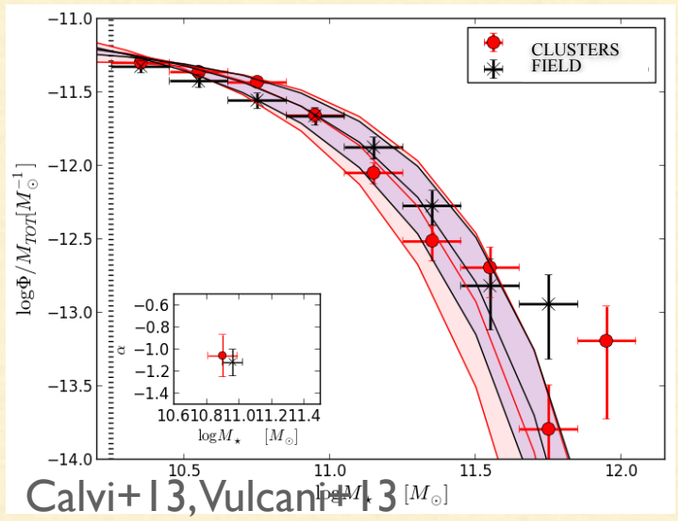
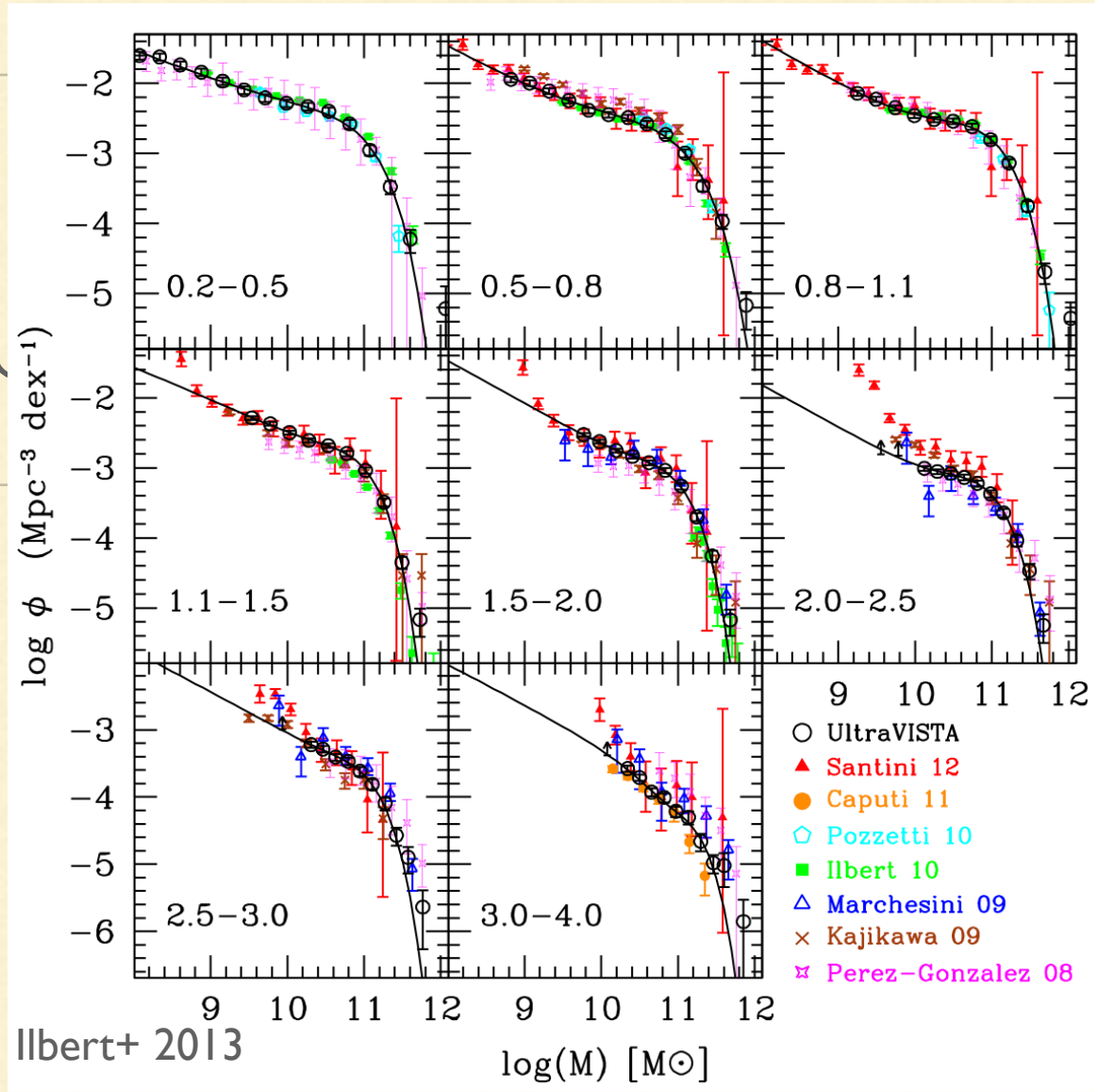


Vulcani+11



Calvi+13, Vulcani+13



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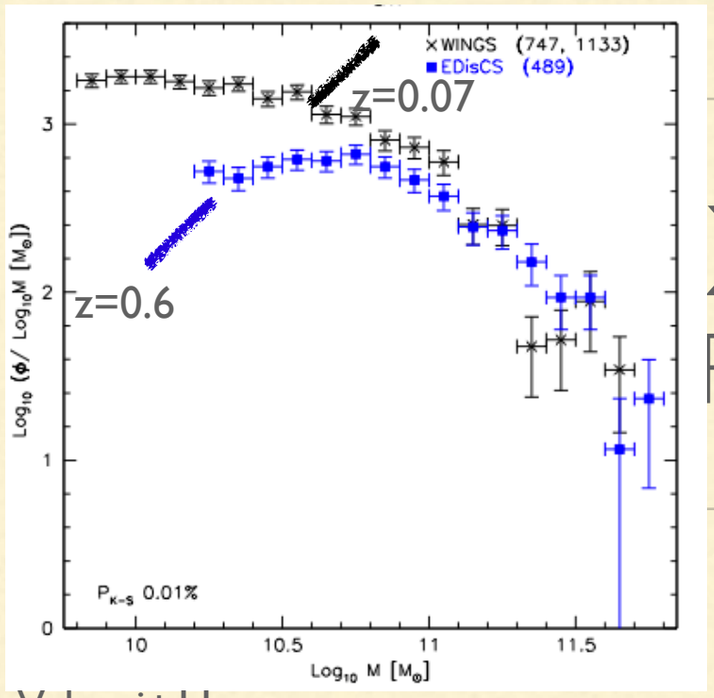

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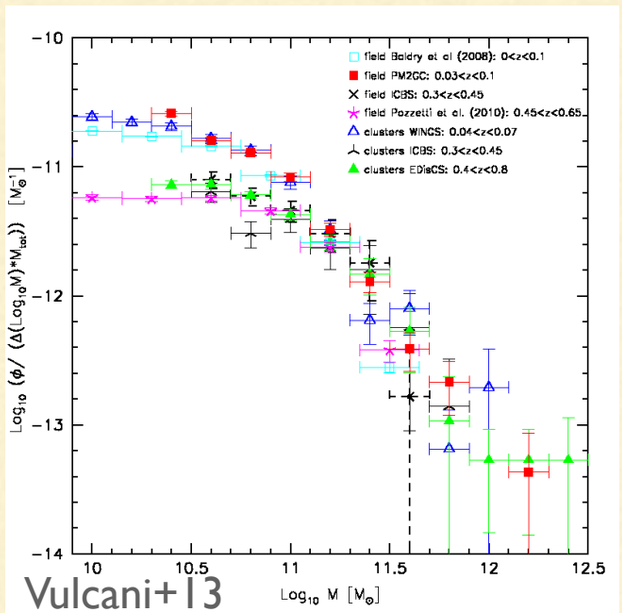
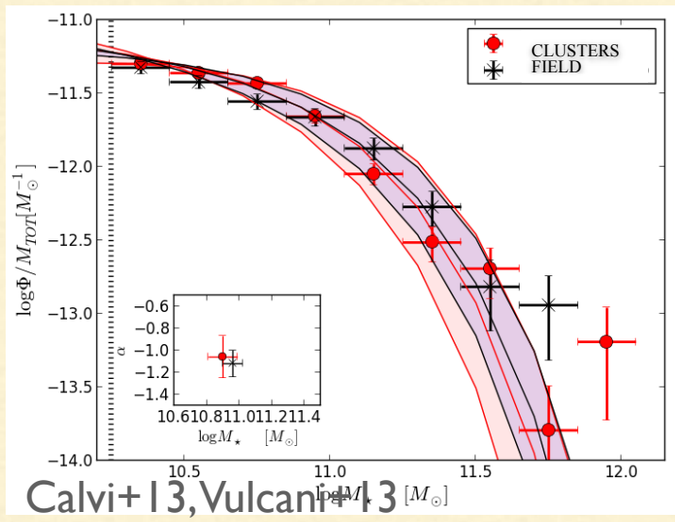


Vulcani+13



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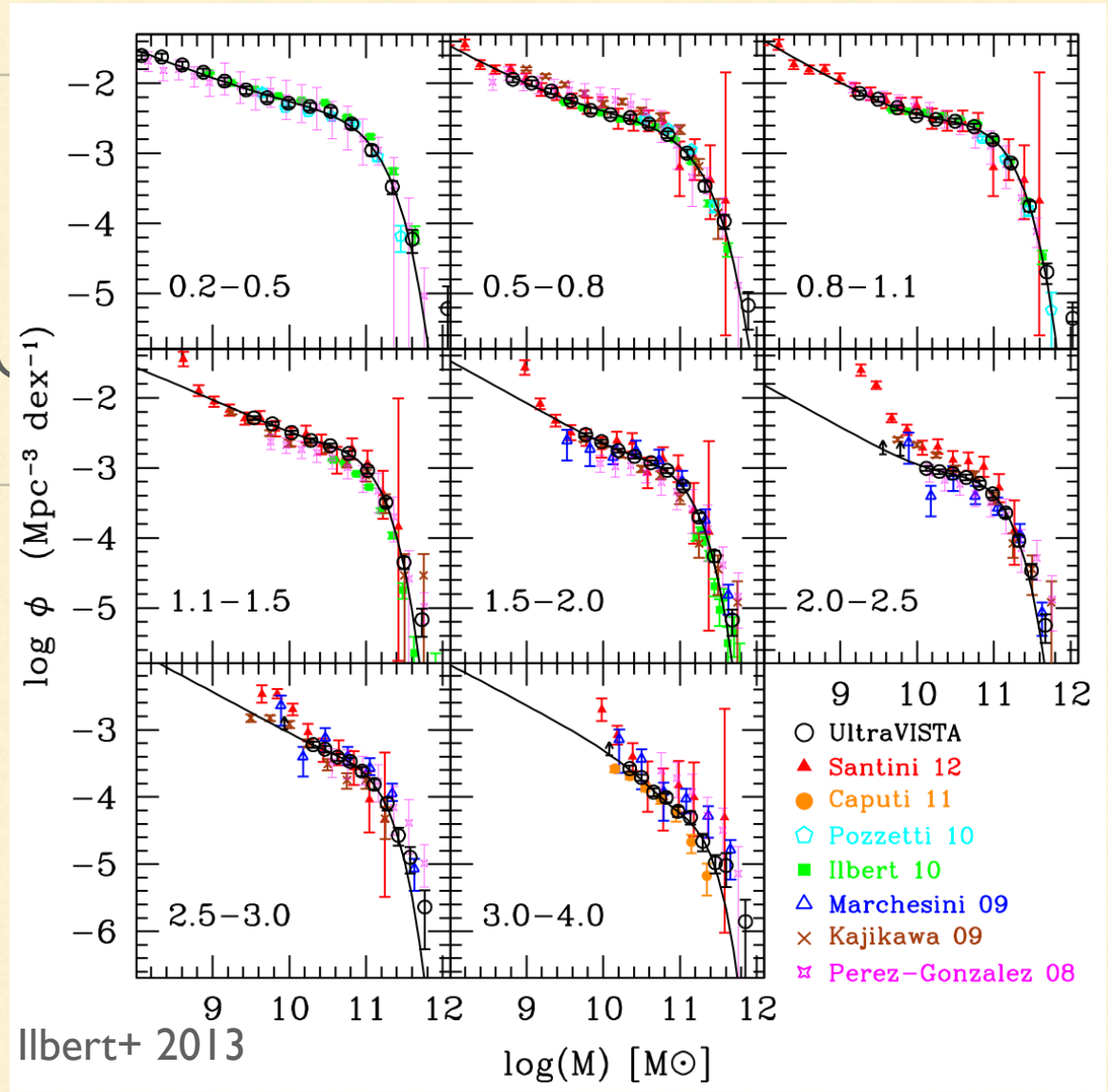

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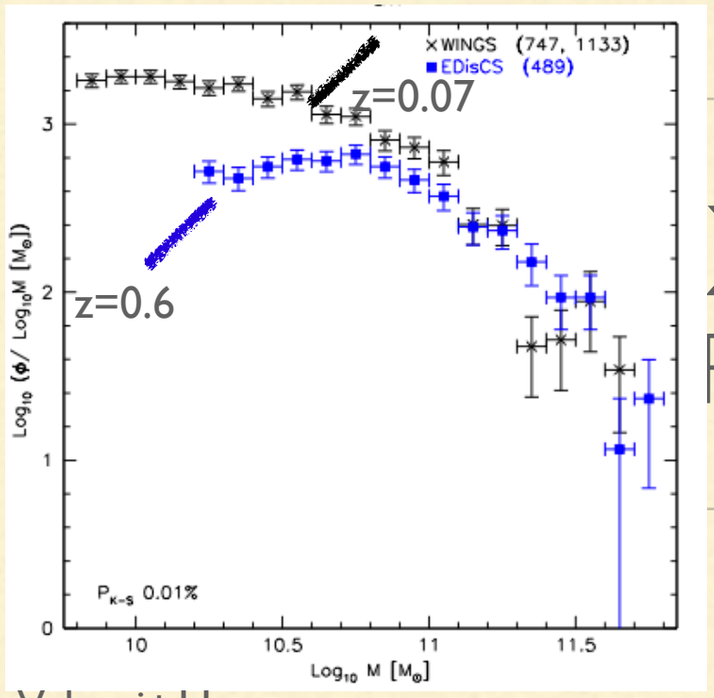

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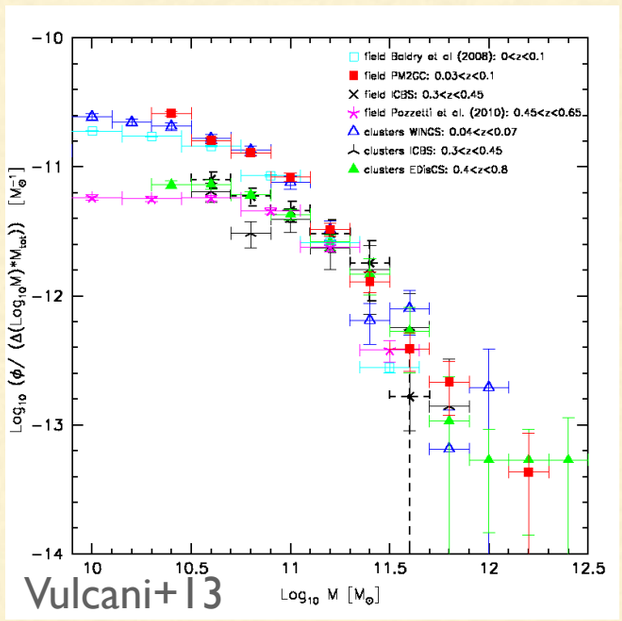

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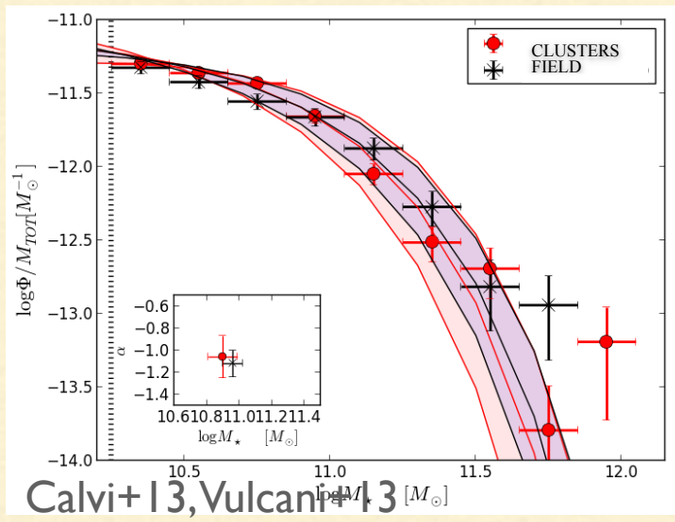

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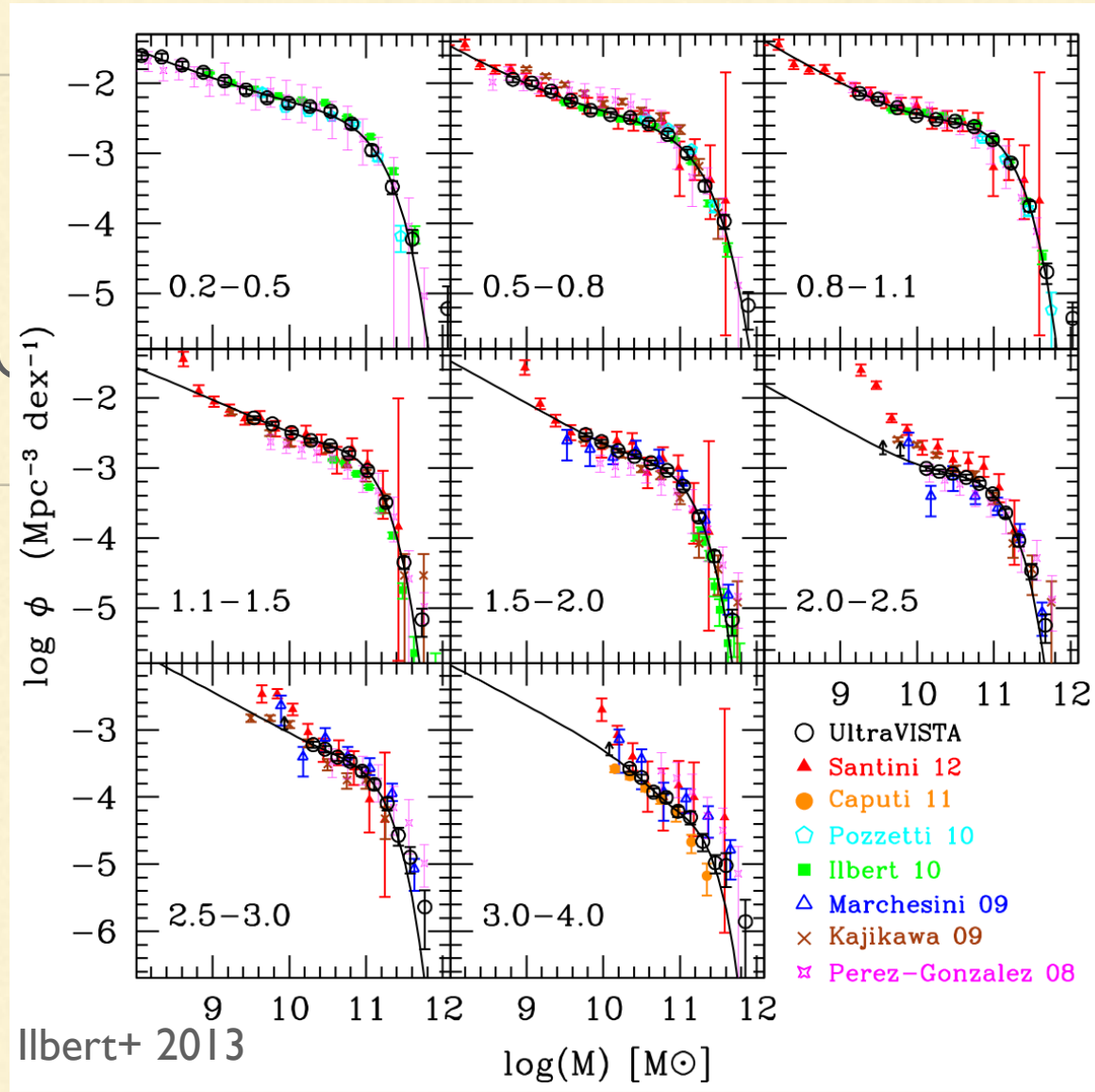

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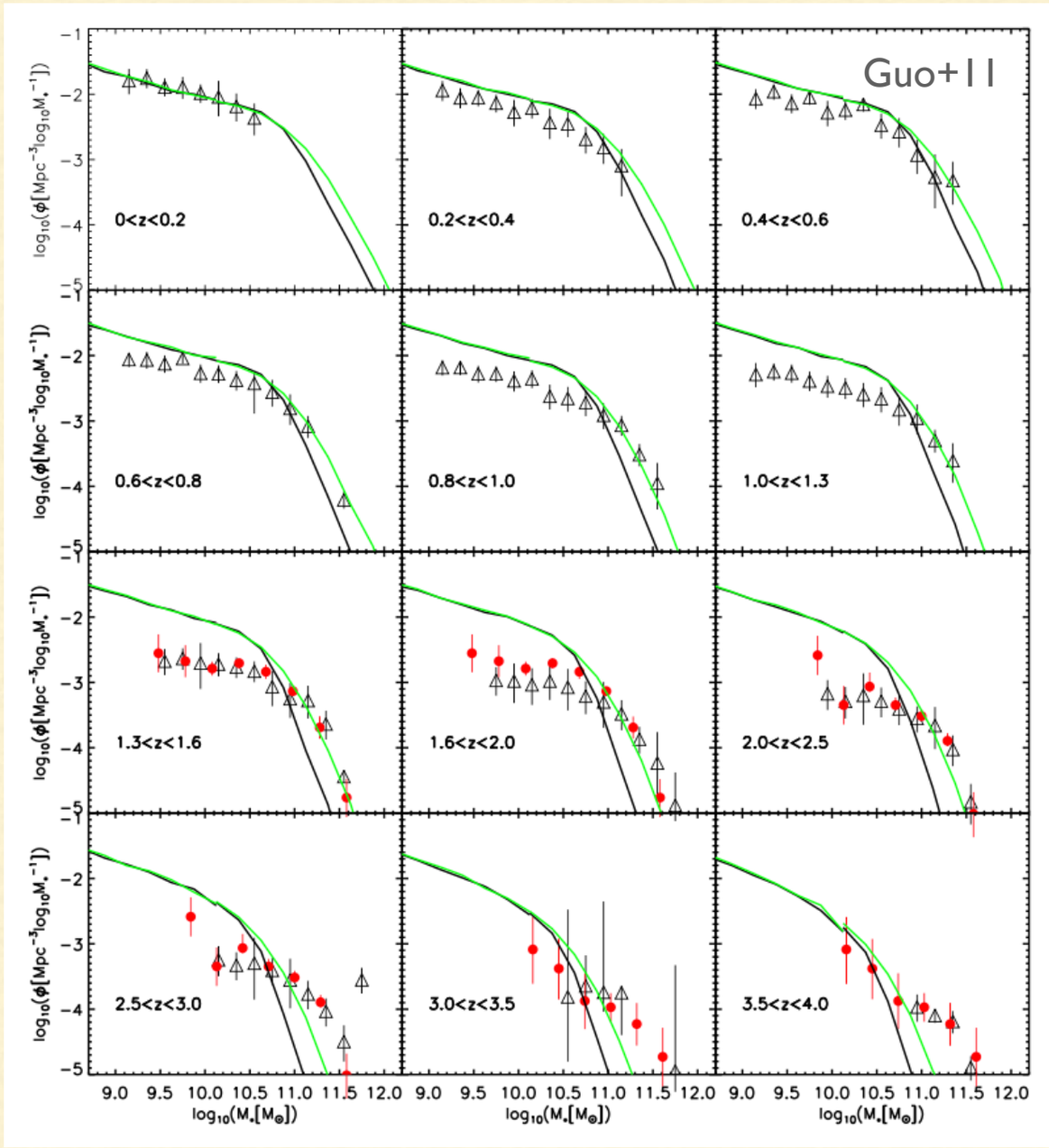
BUT

The mass distribution depends on the local density (e.g. Kauffmann+2004, Baldry +2006, Scodeggio+2009, Bolzonella+2011, Davidzon+13), in all the different global environments (Vulcani+12)

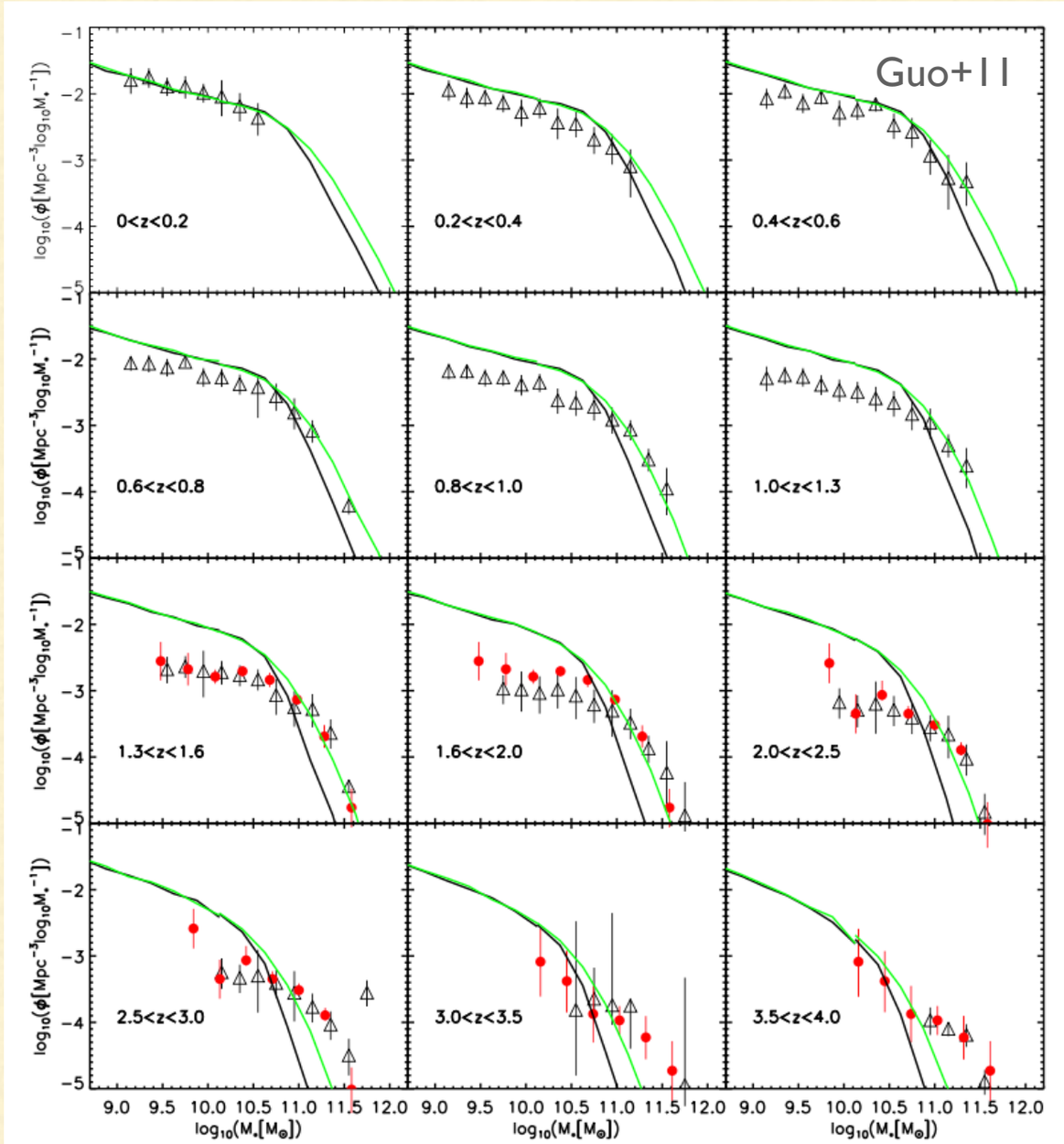
INFLUENCE OF NEARBY GALAXIES VIA HARASSMENT AND INTERACTIONS IS MORE IMPORTANT THAN HALO MASS PROPERTIES

THE STELLAR MASS FUNCTION FROM SEMI-ANALYTIC MODELS



THE STELLAR MASS FUNCTION FROM SEMI-ANALYTIC MODELS

- Semi-analytic models that include strong stellar feedback reproduce the z = 0 mass function well (e.g., Guo+2011, Bower+12)
- Models do not reproduce the MF of low-mass galaxies at higher redshift (e.g. Fontana+06, Marchesini+09, Drory+09, Fontanot+09, Lo Faro+09, Cirasuolo+10, Guo+11)
- The evolution of massive galaxies is too fast (Fontanot+09)
- Similar problems in hydro simulations (Weinmann+12, but see EAGLE, Illustris, FIRE..)



THE STELLAR MASS FUNCTION FROM THE THEORETICAL MODELS

Vulcani+14a

Semi analytic models of De Lucia & Blaizot07 and Guo+11 applied to the MS (Springel+05)

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SIM-PROJECTED SAMPLE (only DLB07)

- comparisons with observational results: PM2GC (field z~0.06), WINGS (clusters z~0.06), COSMOS (field z~0.6), EDisCS (clusters z~0.6)
- Quantities (number of galaxies, velocity dispersion…) are computed from the simulation with the same methods that would be used observationally and are projected on the *xy* plane
- Stellar masses have been computed using Bell & De Jong (2001)
- CLUSTERS: All galaxies within a box of 10 physical Mpc on a side, centered on each halo considered were selected
  - low-z: (10x)21 halos with $550<\sigma<1400$ km/s
  - high-z: (10x)14 halos at $z = 0.62$ halos with $400<\sigma<1100$ km/s.
- FIELD: 10 simulated sky corresponding to square boxes were selected

THE STELLAR MASS FUNCTION FROM THE THEORETICAL MODELS

Vulcani+14a

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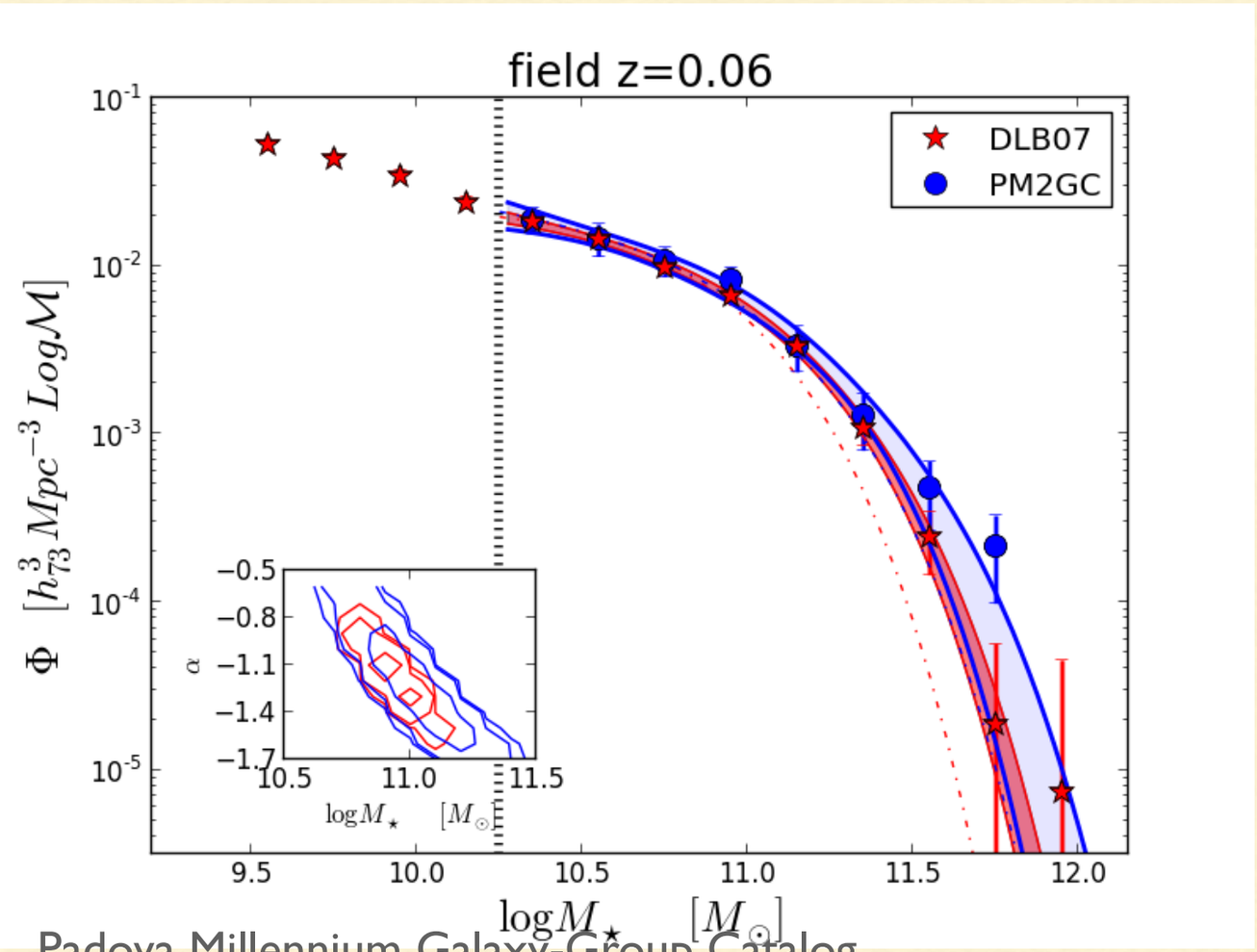
SIMULATED SAMPLE (DLB07 and G11)

- comparisons between models
- 3D values coming from simulations are used
- Stellar masses computed from the models
- CLUSTERS: both at z = 0.06 and 0.62 all halos in three different halo mass bins:
  - 13.25<log Mhalo<13.55 (least massive halos)
  - 13.9<log Mhalo<14.25 (intermediate massive halos)
  - 14.9<log Mhalo<15.25 (most massive halos)
- FIELD: all galaxies from the snapshot corresponding to z = 0.06 and z = 0.62

COMPARISON WITH OBSERVATIONS low-z

Vulcani+14a

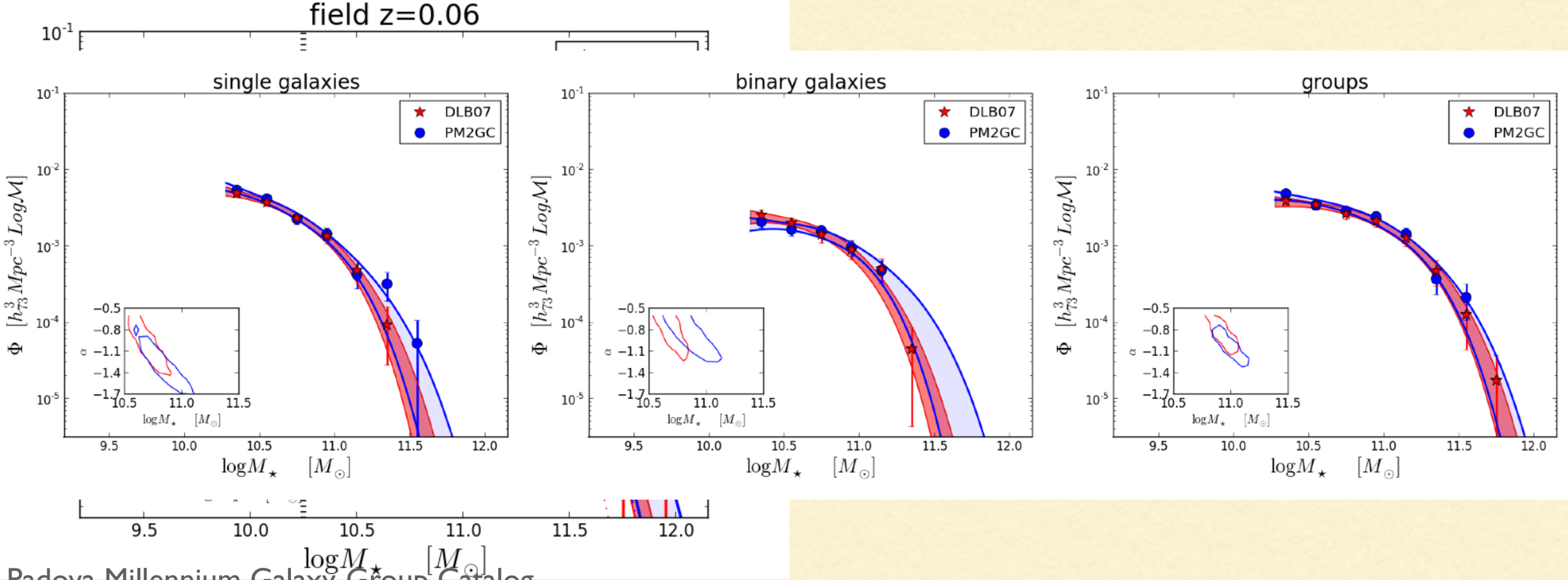


Padova Millennium Galaxy-Group Catalog
(Calvi, Poggianti, BV 2011, 2013)

Wide-field Nearby Galaxy-clusters Survey
(Fasano+2011, Vulcani+2011)

COMPARISON WITH OBSERVATIONS low-z

Vulcani+14a



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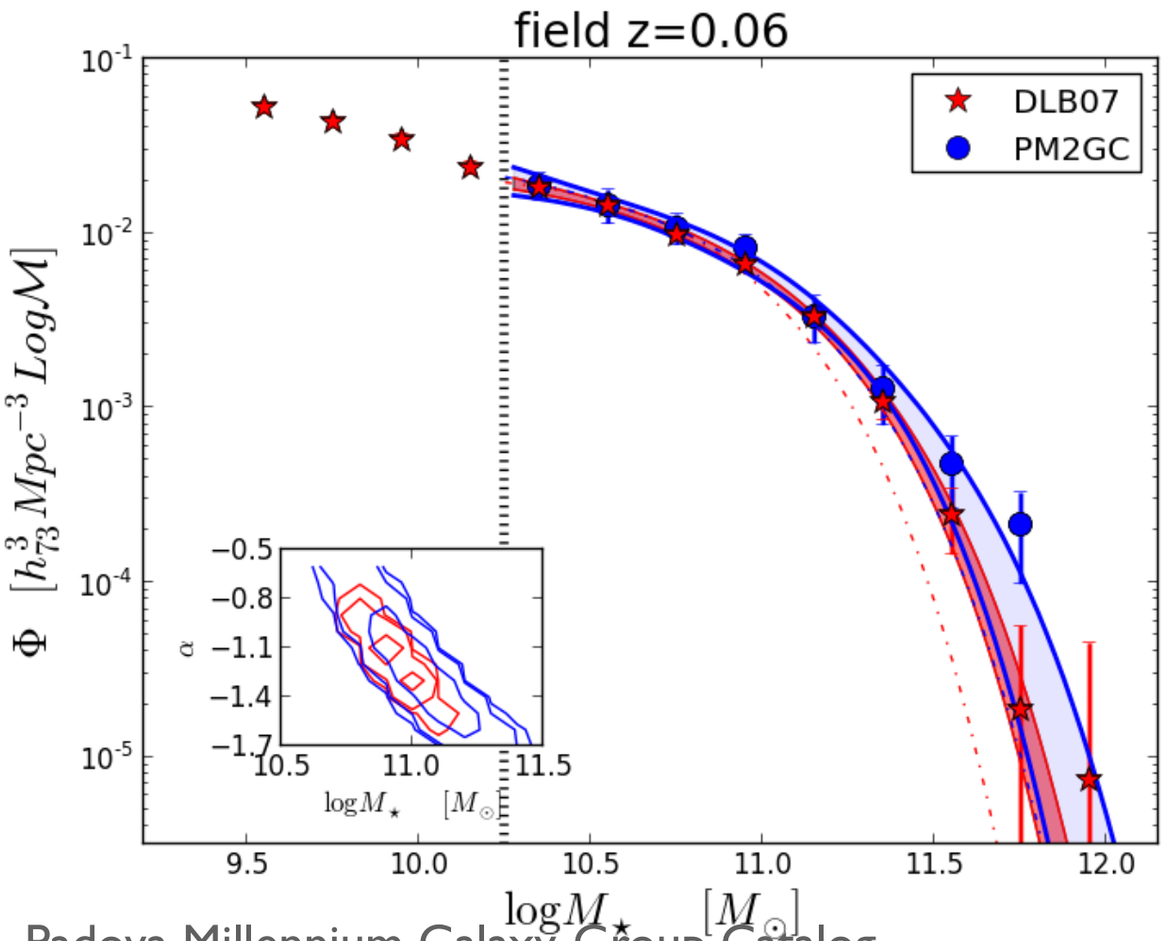

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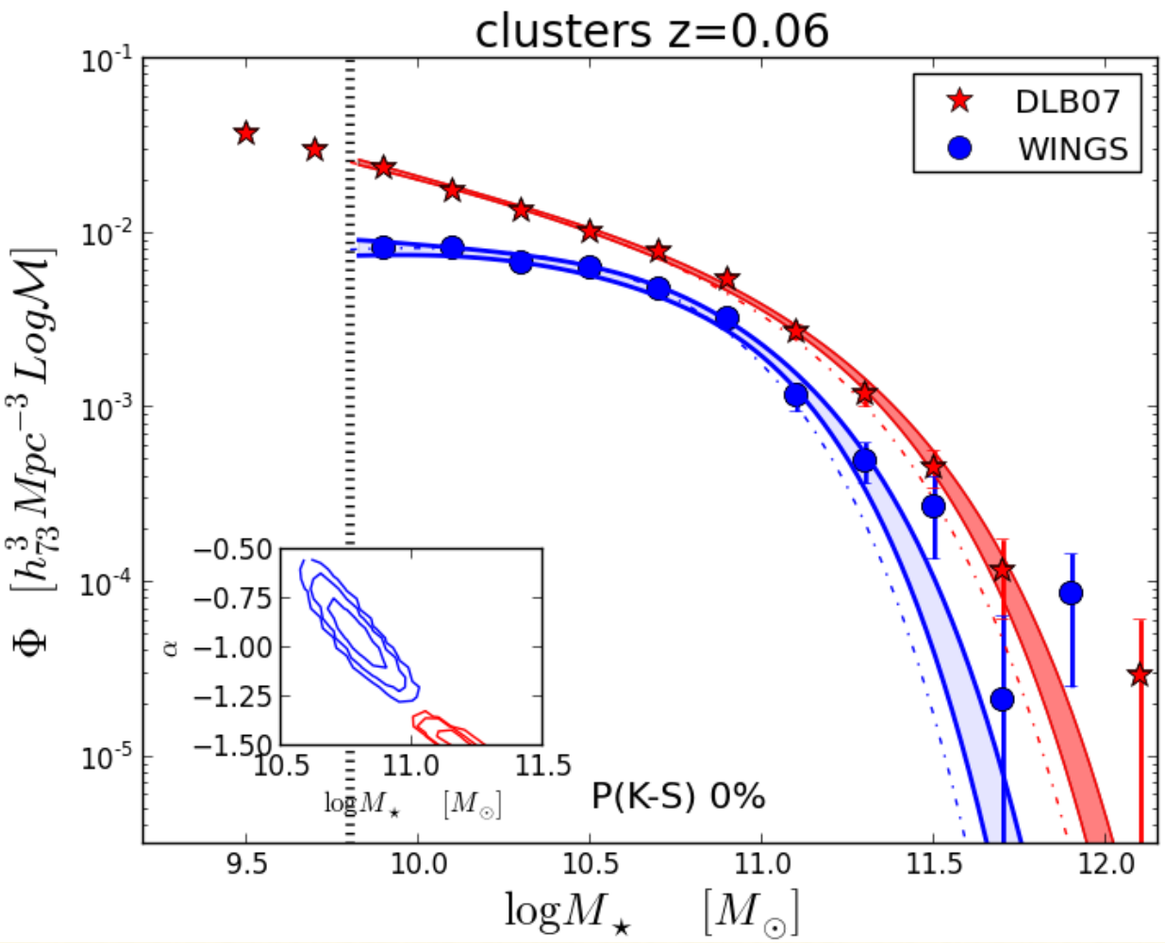

Wide-field Nearby Galaxy-clusters Survey
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COMPARISON WITH OBSERVATIONS high-z

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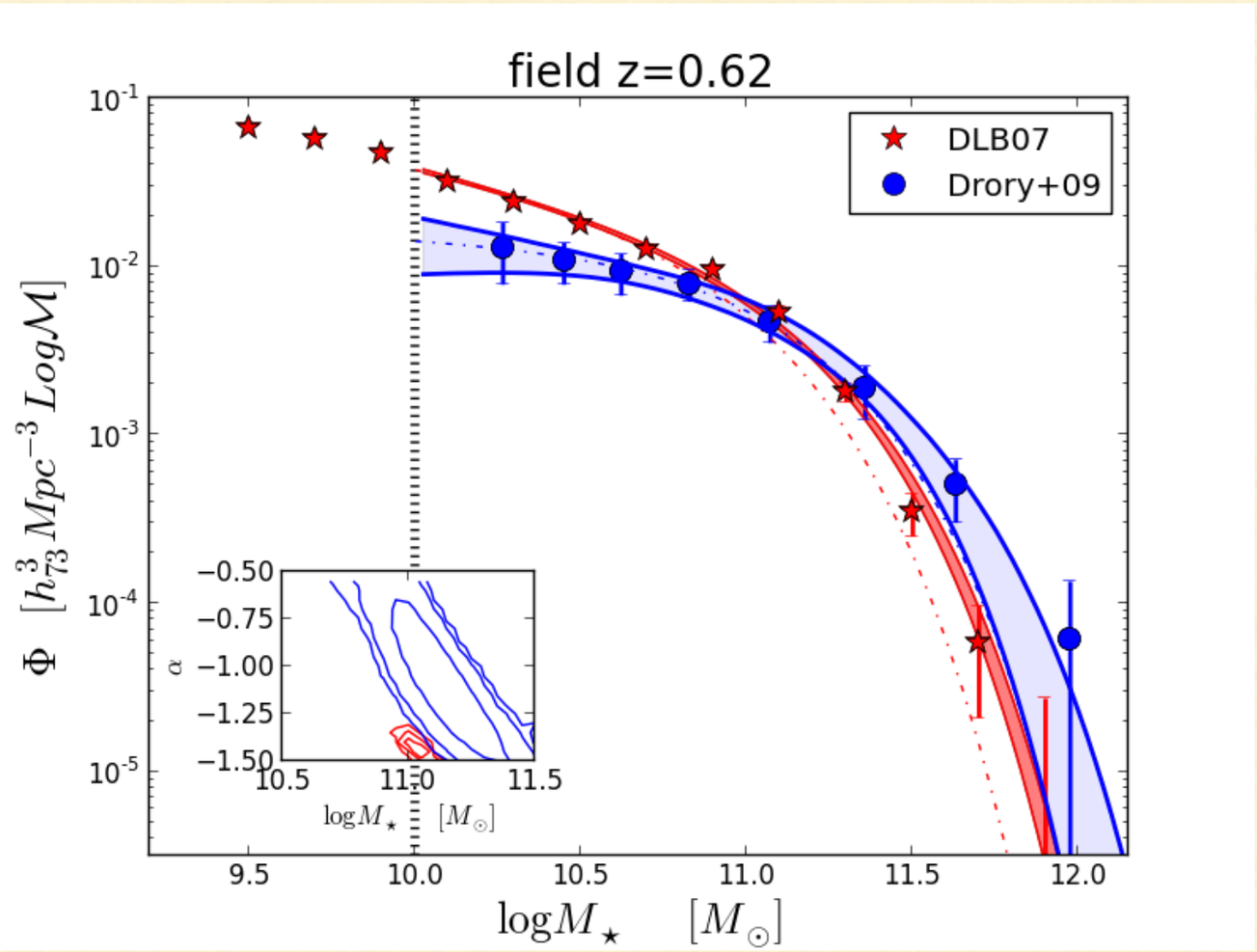

COSMOS (from Drory+2009)

ESO Distant Cluster Survey (White+2005, Vulcani+2011)

COMPARISON WITH OBSERVATIONS high-z

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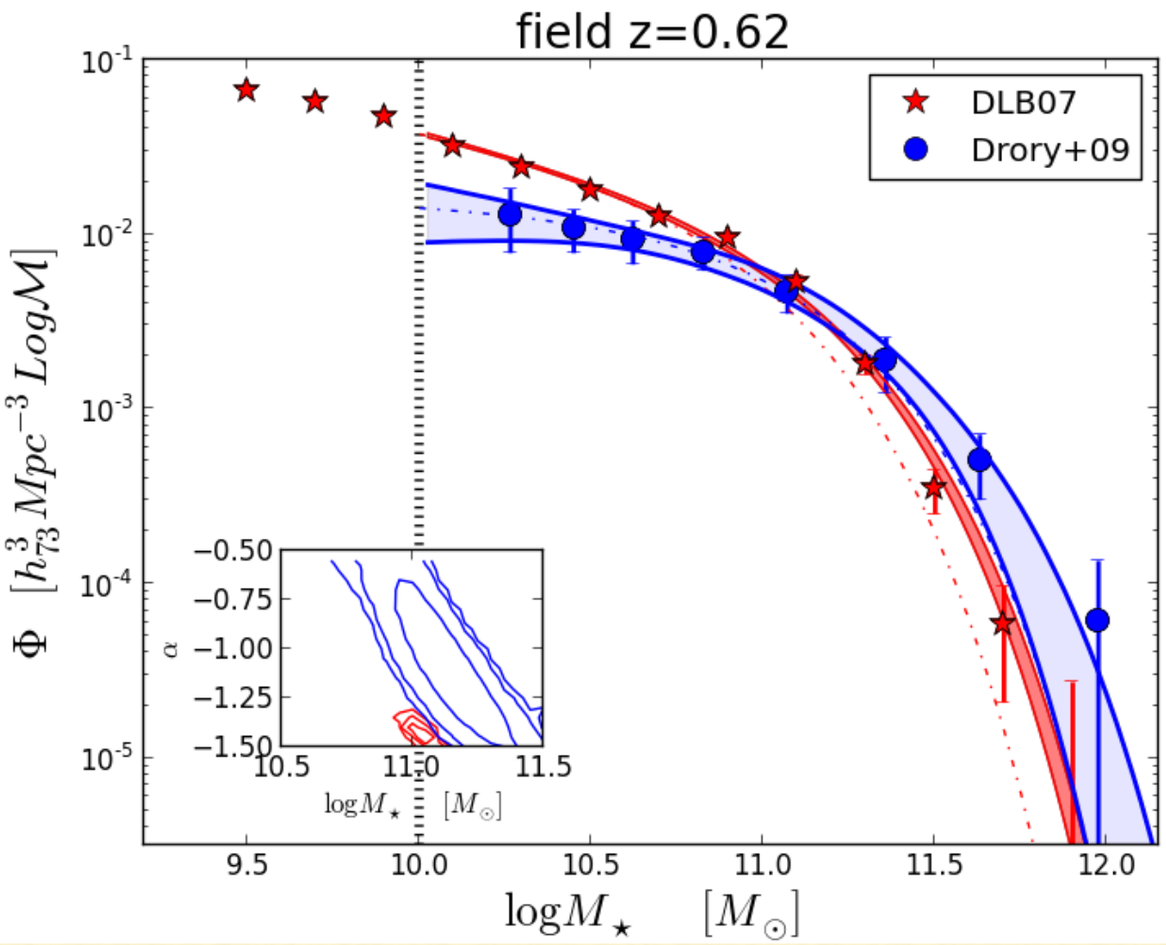

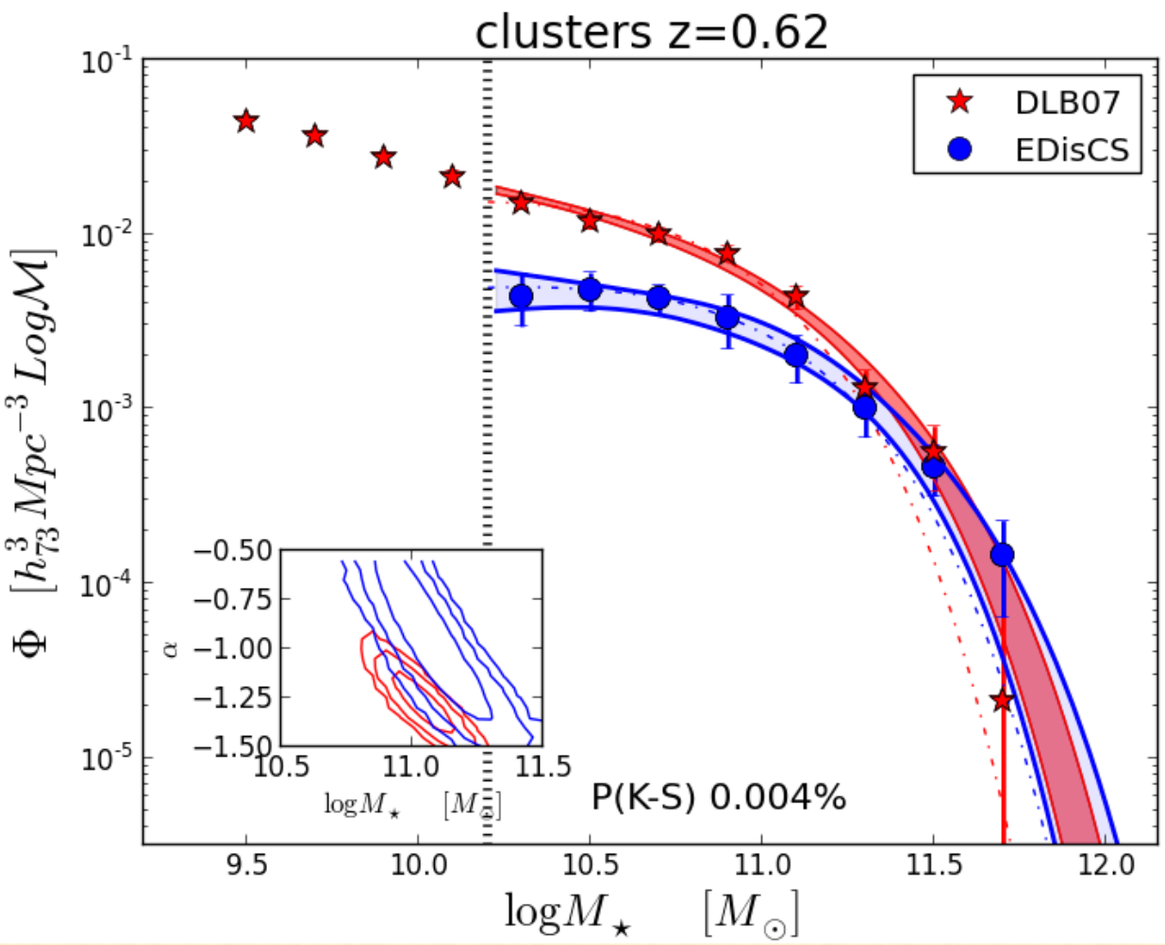

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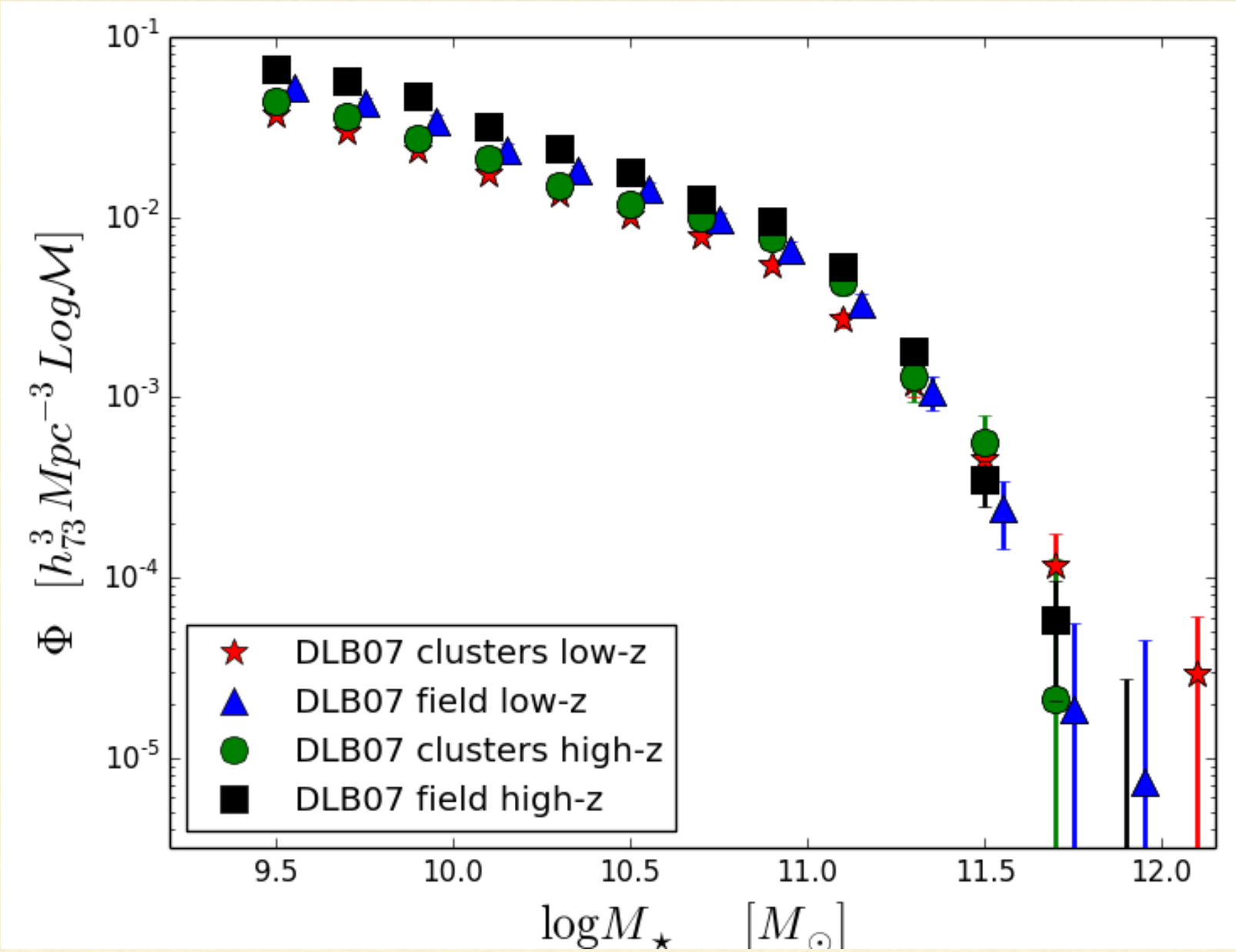
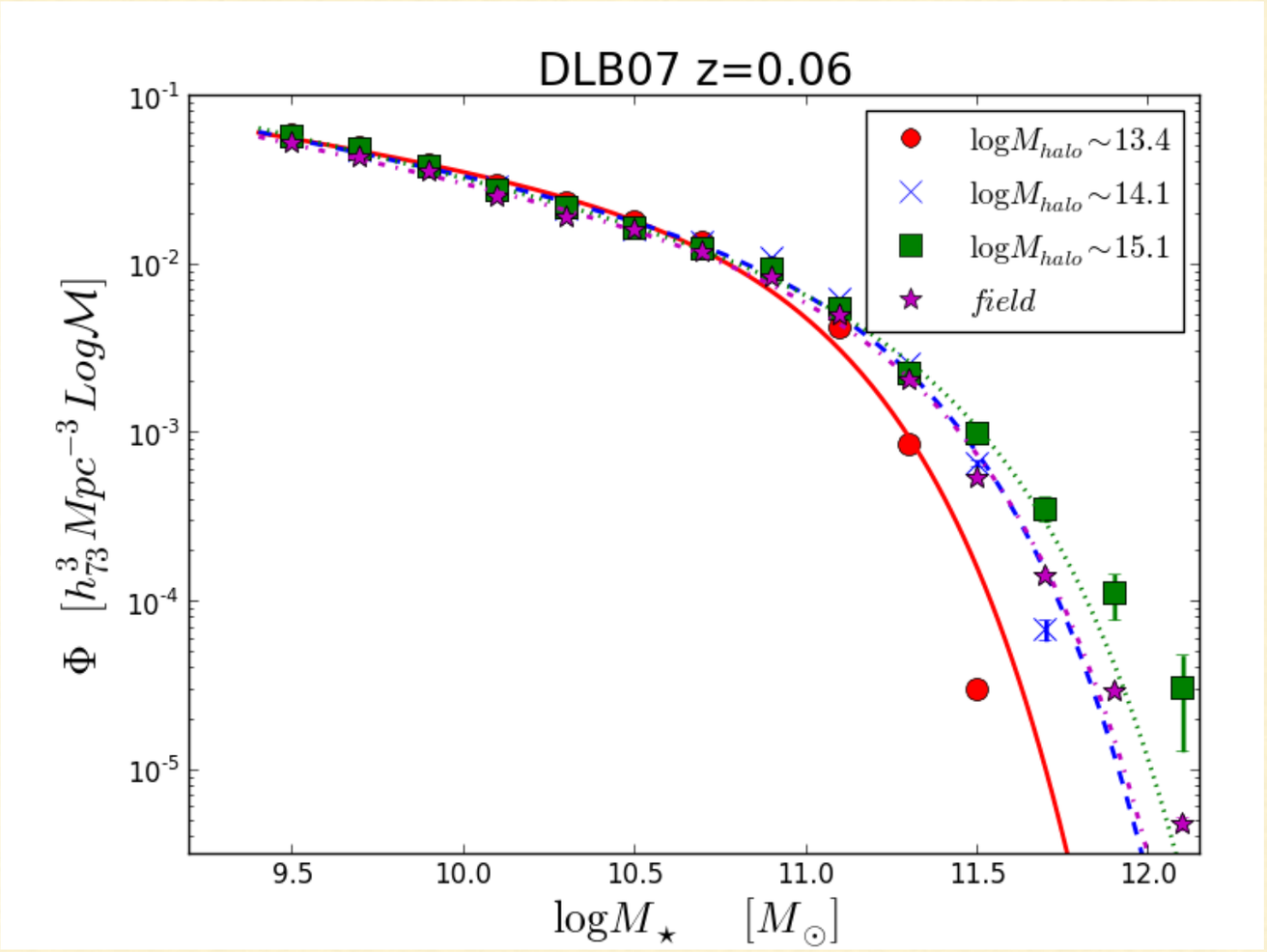
EVOLUTION FROM Z=0.6 TO Z=0

Vulcani+14a



THE SIMULATED MASS FUNCTION low-z

Vulcani+14a



similar results at z=0.6

THE SIMULATED MASS FUNCTION low-z

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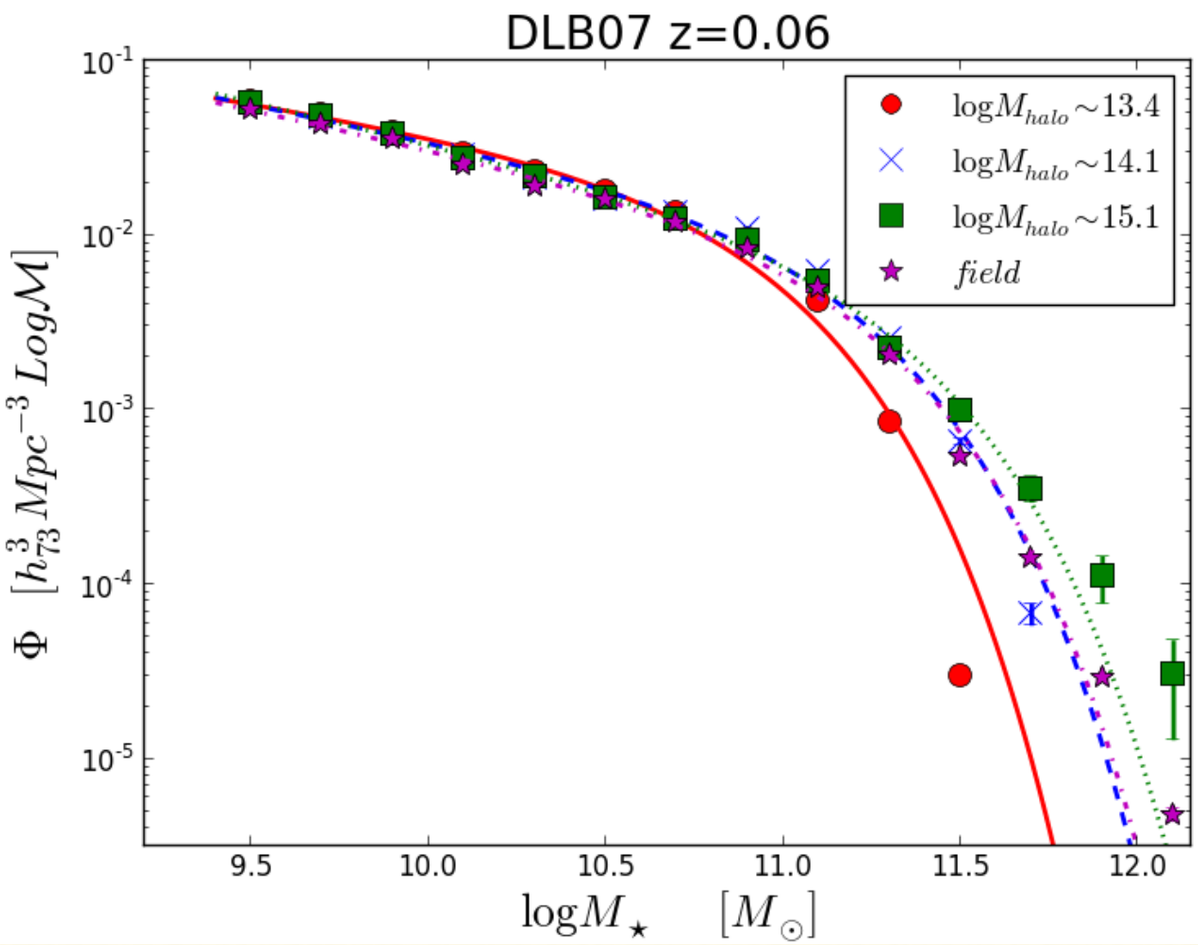
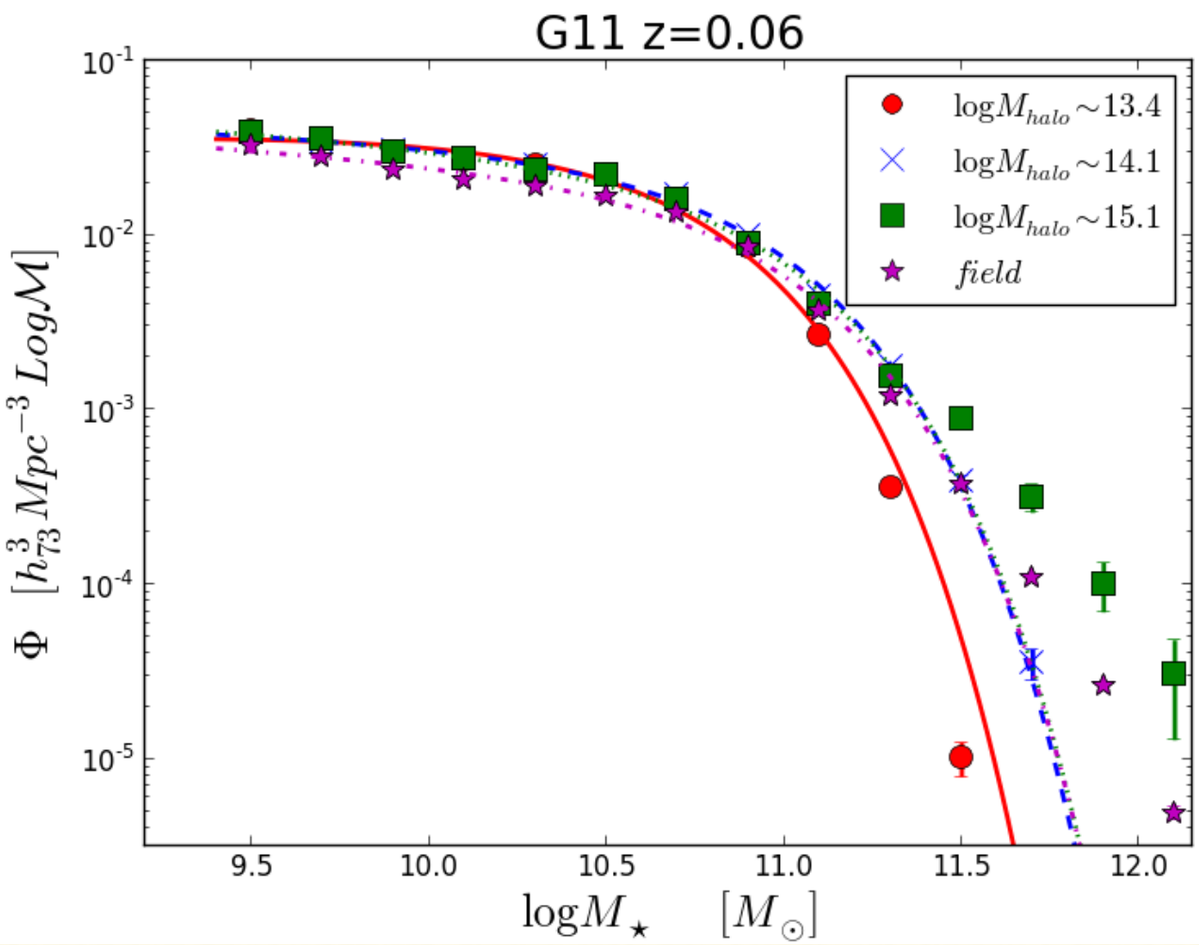
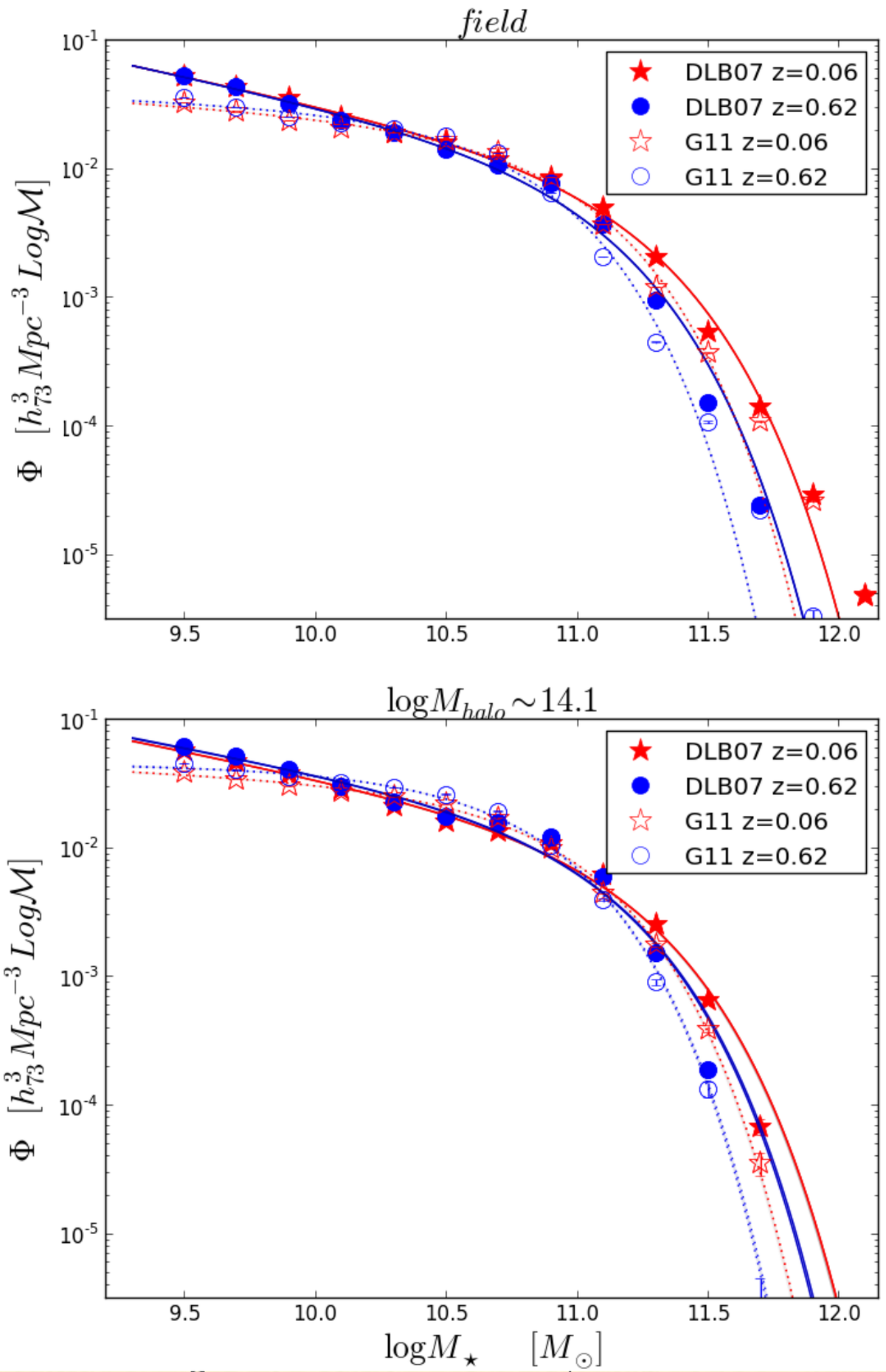


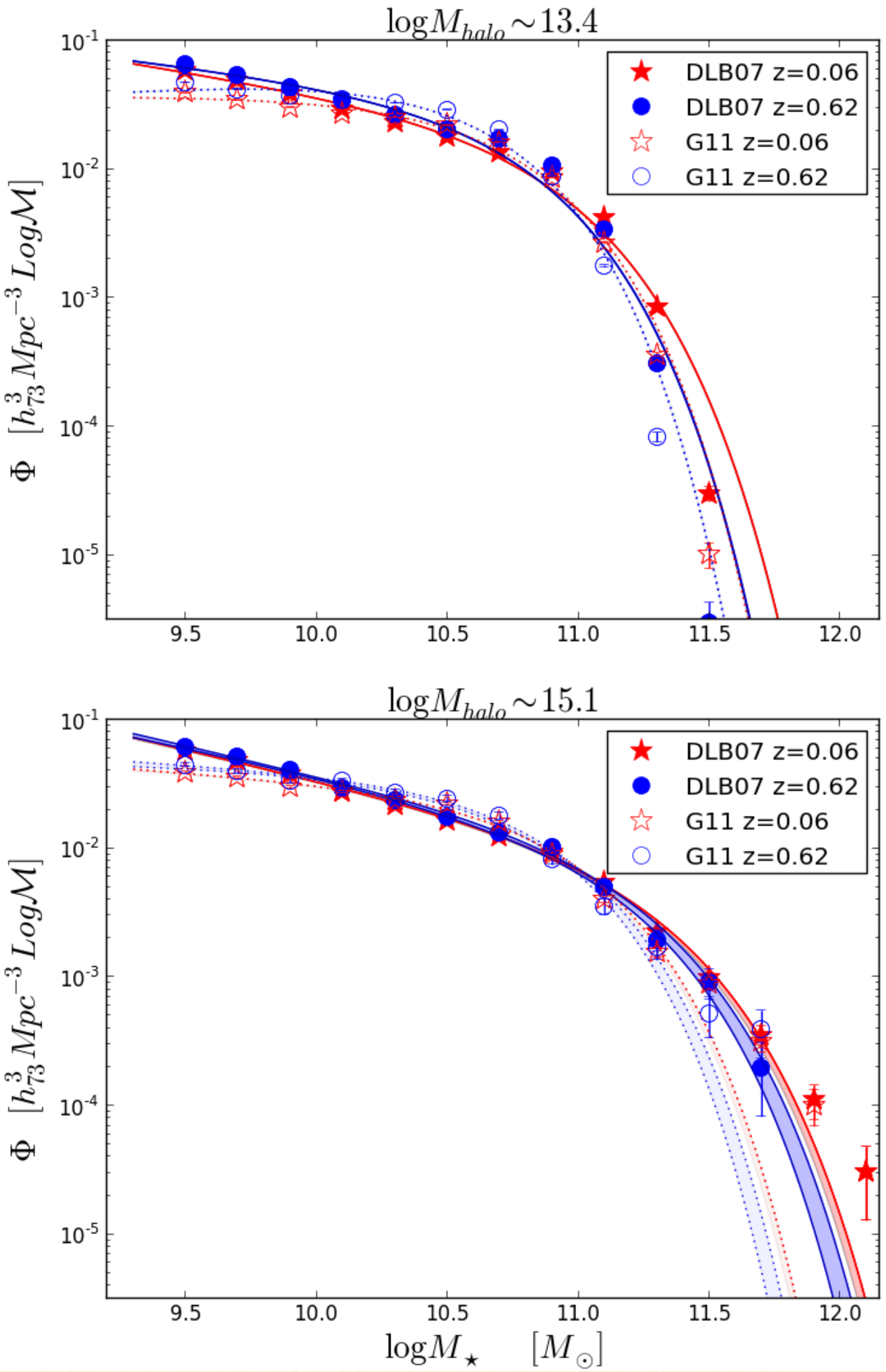


similar results at z=0.6

THE SIMULATED MASS FUNCTION evolution

Vulcani+14a


field
DLB07 z=0.06
DLB07 z=0.62
G11 z=0.06
G11 z=0.62
$\Phi \quad [h_{73}^3 Mpc^{-3} Log\mathcal{M}]$
$\log M_\star \quad [M_\odot]$


$\log M_{halo} \sim 13.4$
DLB07 z=0.06
DLB07 z=0.62
G11 z=0.06
G11 z=0.62
$\Phi \quad [h_{73}^3 Mpc^{-3} Log\mathcal{M}]$
$\log M_\star \quad [M_\odot]$

$\log M_{halo} \sim 14.1$
DLB07 z=0.06
DLB07 z=0.62
G11 z=0.06
G11 z=0.62
$\Phi \quad [h_{73}^3 Mpc^{-3} Log\mathcal{M}]$
$\log M_\star \quad [M_\odot]$

$\log M_{halo} \sim 15.1$
DLB07 z=0.06
DLB07 z=0.62
G11 z=0.06
G11 z=0.62
$\Phi \quad [h_{73}^3 Mpc^{-3} Log\mathcal{M}]$
$\log M_\star \quad [M_\odot]$

SUMMARY

- DLB07 model matches the field mass function (and its finer environments) at z = 0, BUT fails to reproduce the observed mass function of clusters at low z and overpredicts the number of low-mass galaxies in both clusters and field at z ~ 0.6.

- In sim-projections, the observed evolution of the shape of the mass function is not reproduced, neither in the field nor in clusters.

- In simulations, in both models, the MF depends on the mass of the halo, both at z = 0.06 and z = 0.62. Simulations also detect a mass segregation with the environment: low- mass halos do not host massive galaxies.

- In both models, the overall shape of the mass function does not strongly depend on the halo-centric distance, once redshift and halo mass are controlled.

- In both models, the shape of the mass function for log $M_\star / M_\odot < 11.2$ does not evolve, in any environment. In contrast, there is an evolution in the number of the most massive galaxies, which are more numerous in the local universe.

CLUSTER PHYSICAL PROCESSES AND THE REDSHIFT-DEPENDENT EVOLUTION STILL NEEDS TO BE BETTER MODELED IN SAMs!