THE EVOLUTION OF THE GALAXY MASS ASSEMBLY AND STAR FORMATION ACTIVITY FROM Z=1 TO Z=0 AS A FUNCTION OF ENVIRONMENT

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Outlines

* THE GALAXY STELLAR MASS FUNCTION
    * its importance
    * in different global environments
    * at different cosmic times

* THE STAR FORMATION RATE- MASS RELATION
    * its importance
    * in different global environments
    * at different cosmic times

Sample used @ low-z

Wide field Nearby Galaxy-cluster Survey (WINGS - Fasano+ 2006):

- 0.04<z<0.07
- Spectroscopic data of 21 clusters
- Morphologies determined on V images, automatic classification with MORPHOT (Fasano+ 2011)
- Stellar masses determined using the relation between L_B and B-V color (Bell & De Jong 2001), Kroupa (2001) IMF adopted
- Mass limited sample, limit: log(M/Msun)>9.8

Samples used @ intermediate-z

ESO Distant Cluster Survey (EDisCS - White+ 2005):

* 0.5<z<0.8
* Spetroscopic and photo-z data of clusters and groups
* Morphologies determined using HST images, visual classification
* Stellar masses determined using the relation between L_B and B-V color (Bell & De Jong 2001), Kroupa (2001) IMF adopted
* Mass limited sample, limit: log(M/Msun)>10.2

Samples used @ intermediate-z

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IMACS Cluster Building Survey (ICBS - Oemler+ 2012):

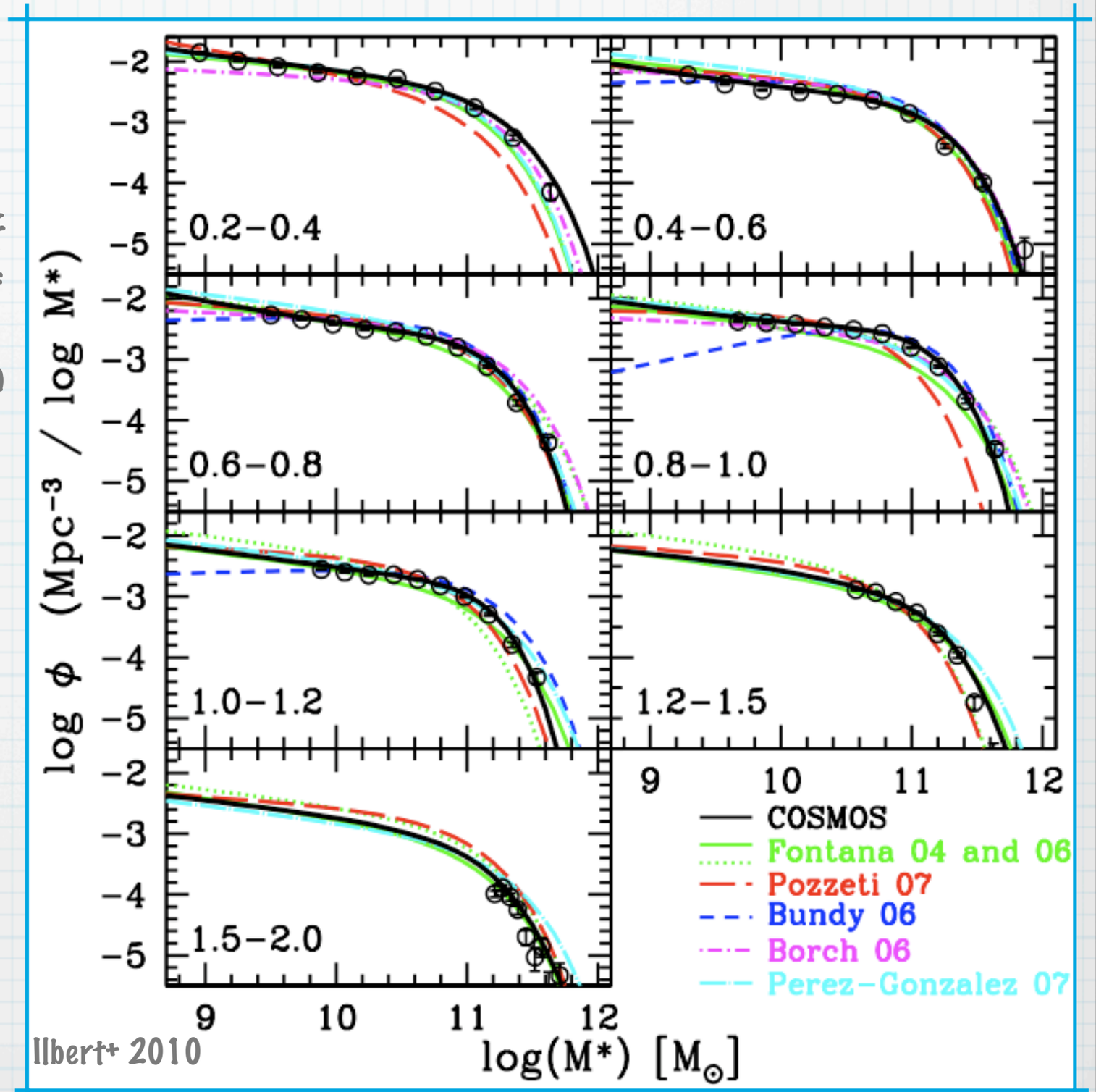
* 0.25<z<0.5
* Spectroscopic data of clusters, groups and field
* Stellar masses determined using the relation between L_B and B-V color (Bell & De Jong 2001), Kroupa (2001) IMF adopted
* Mass limited sample, limit: log(M/Msun)>10.55

The MF in the field

(e.g. Fontana+ 2006, Bundy+ 2006, Franceschini+ 2006, Borch+ 2006, Vergani+ 2008, Pozzetti+ 2009, Bolzonella+ 2010)

For high mass galaxies, the evolution of the total mass function from z = 1 to z = 0 is relatively modest

Low mass galaxies evolve more then high mass galaxies



Ilbert+ 2010

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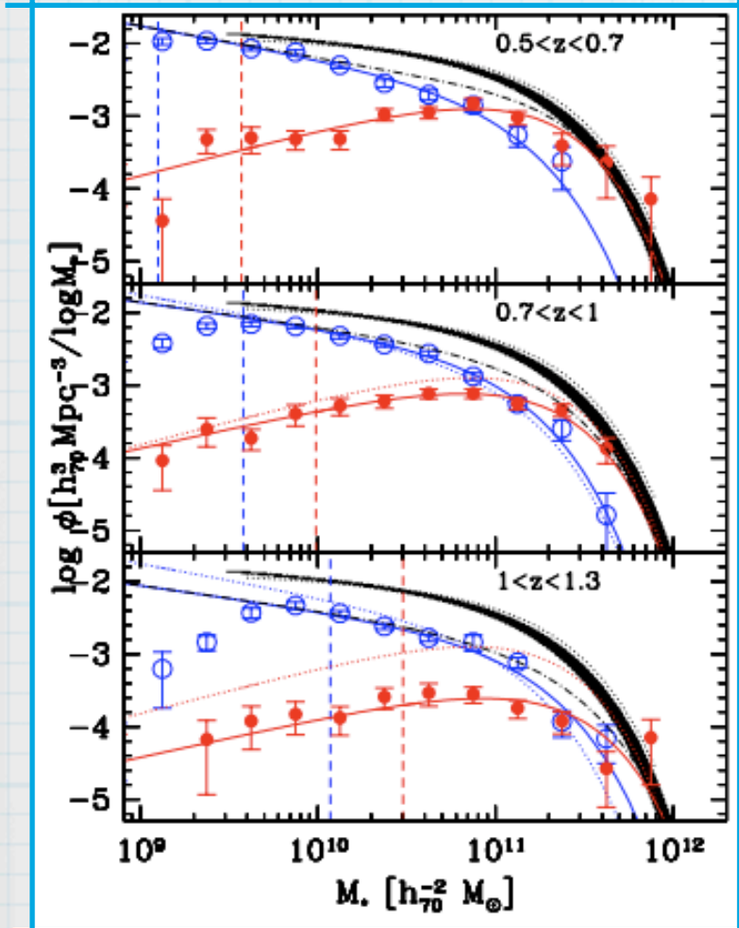
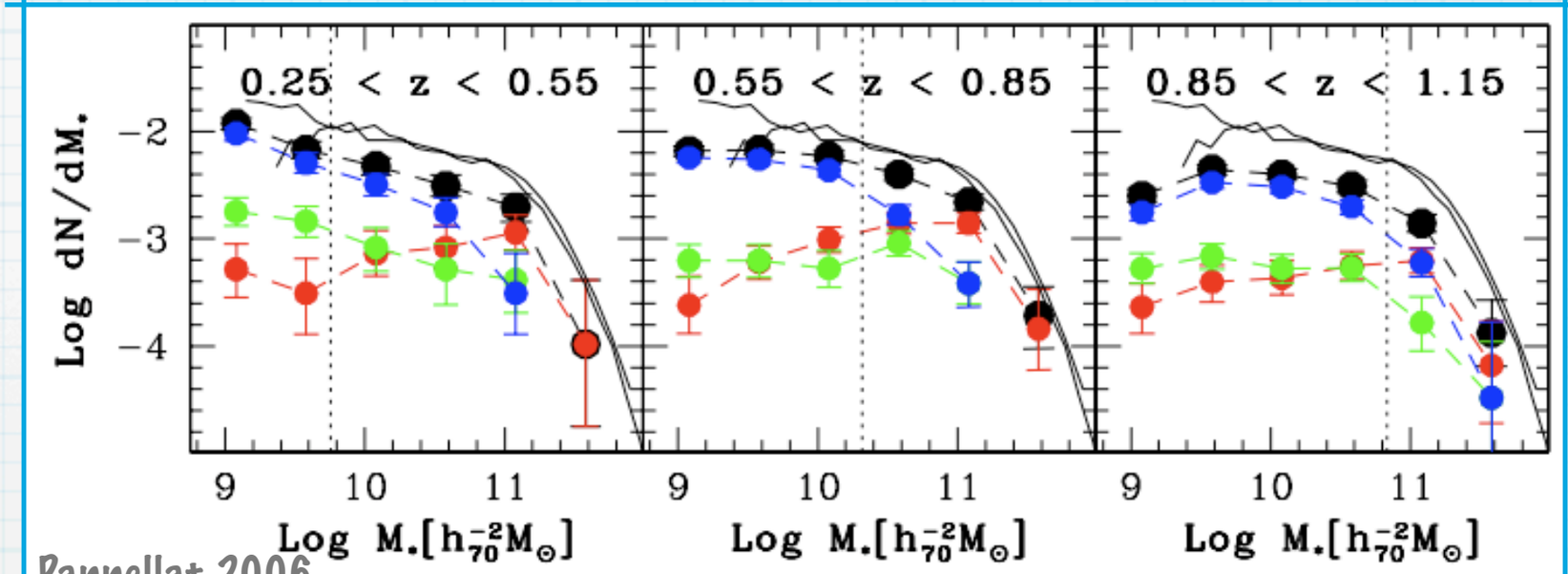
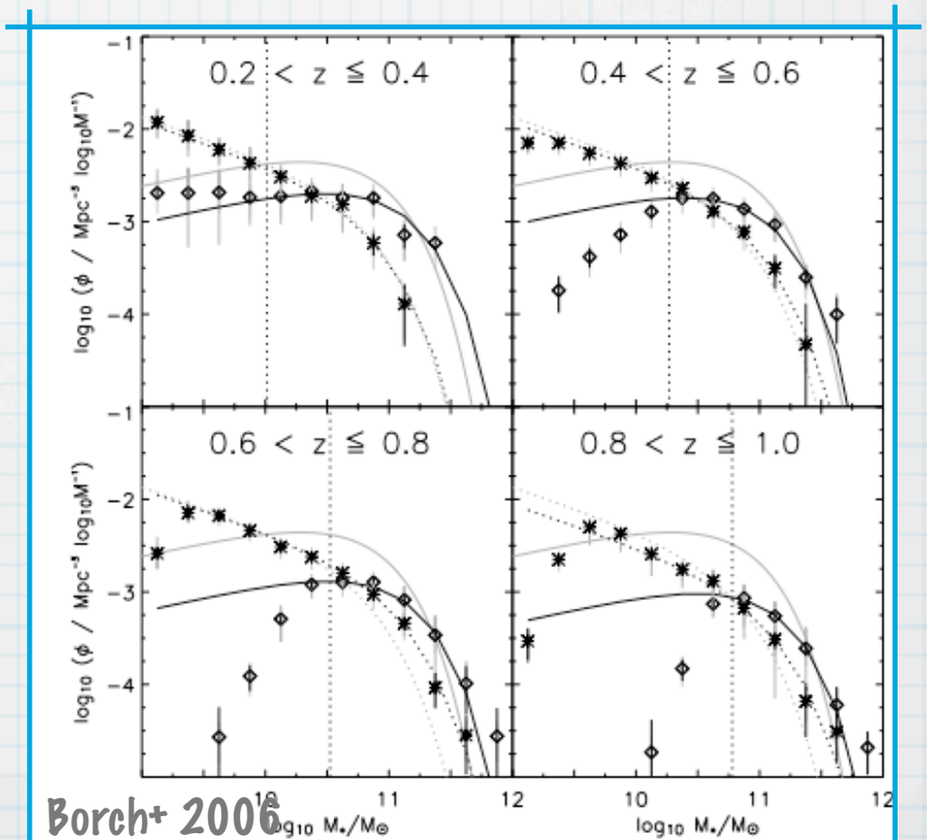


Vergani + 2008



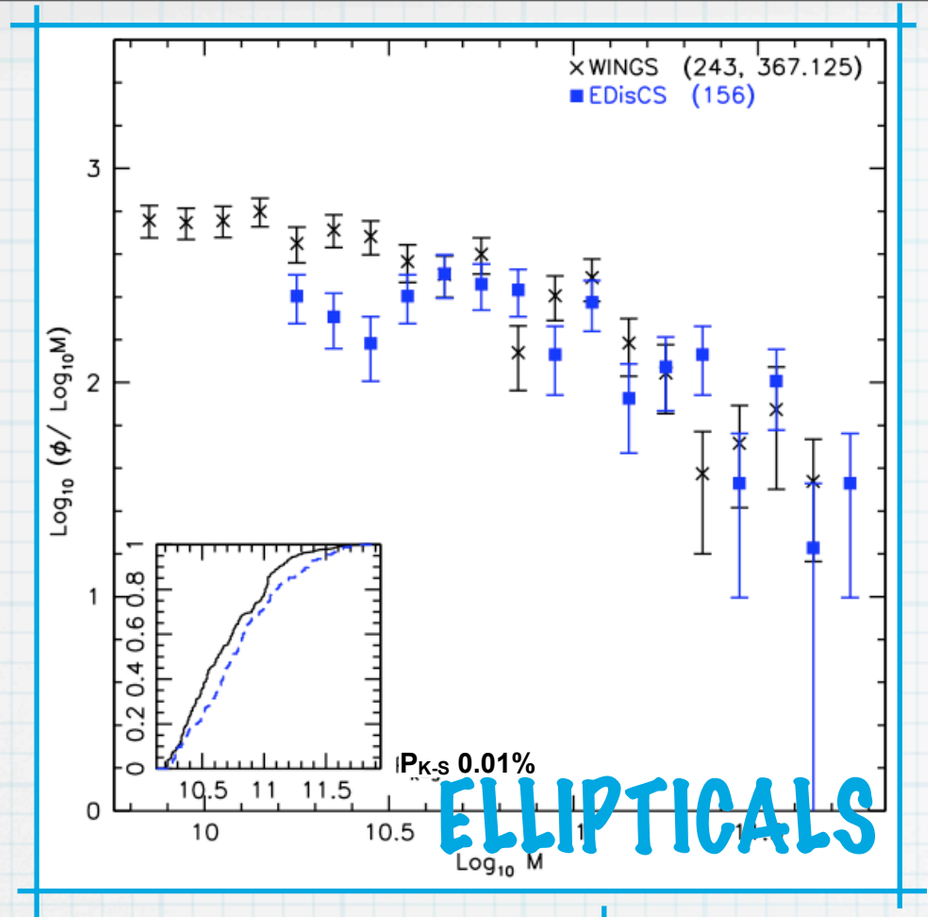
Pannella+ 2006

Several studies have analyzed separately galaxies of different types (according to colors, star formation activity, structural parameters, morphologies)

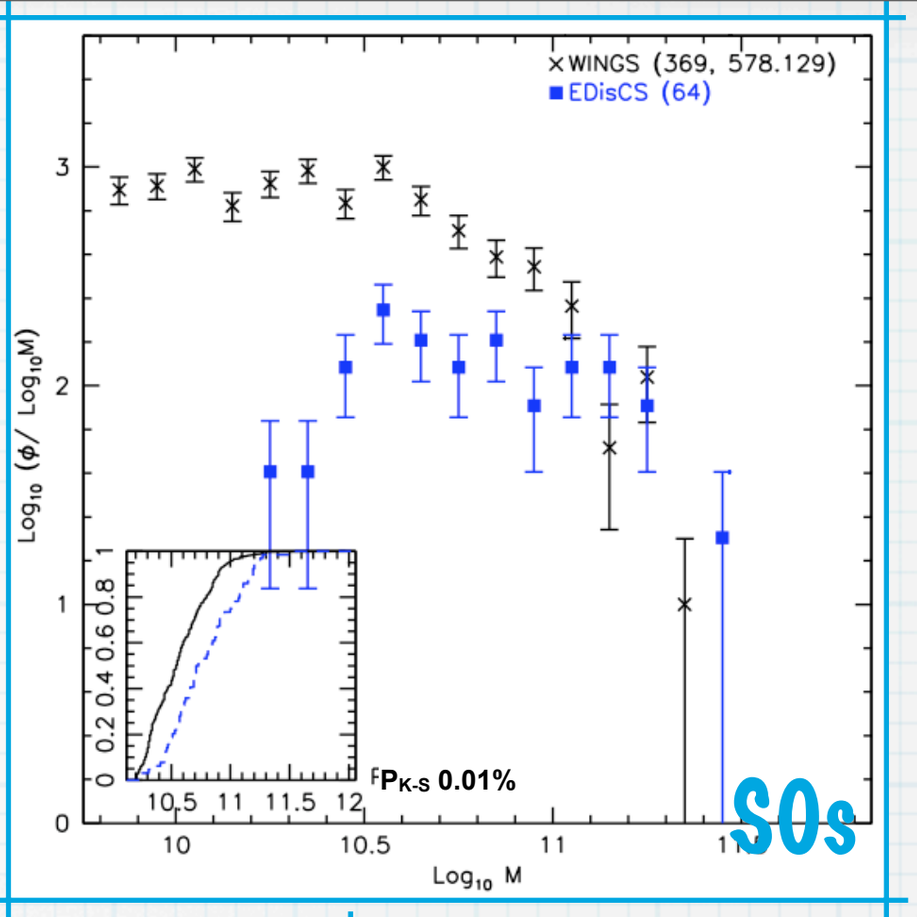


Borch+ 2006

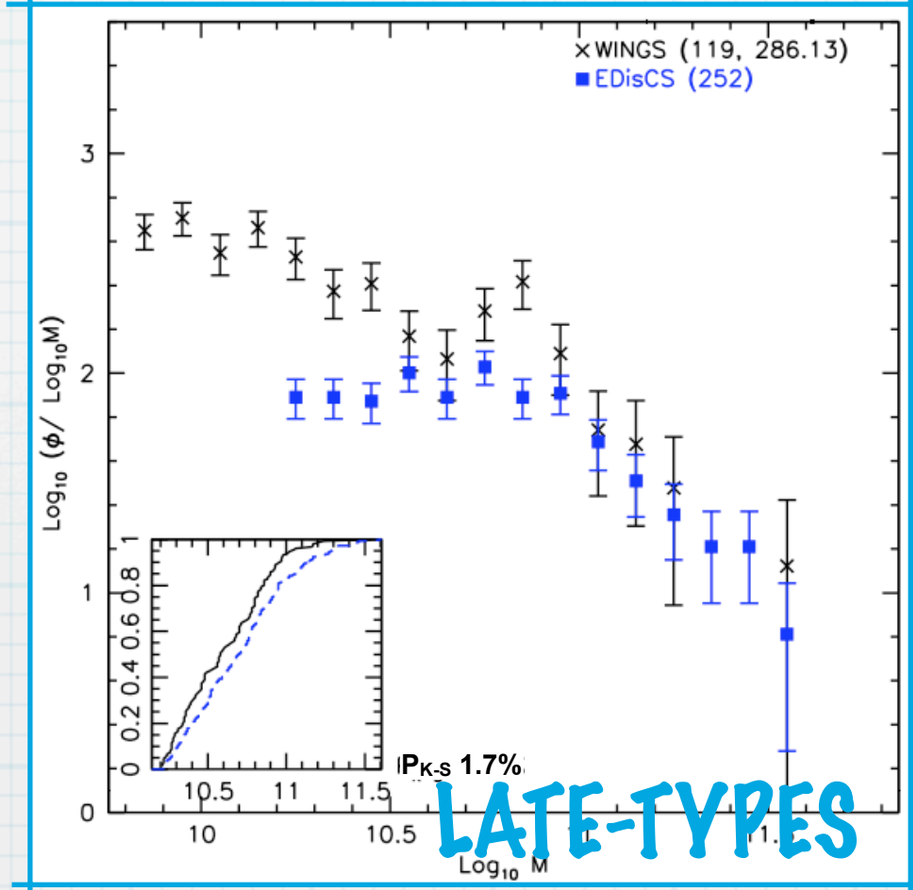
Evolution of the MF of each morphological type



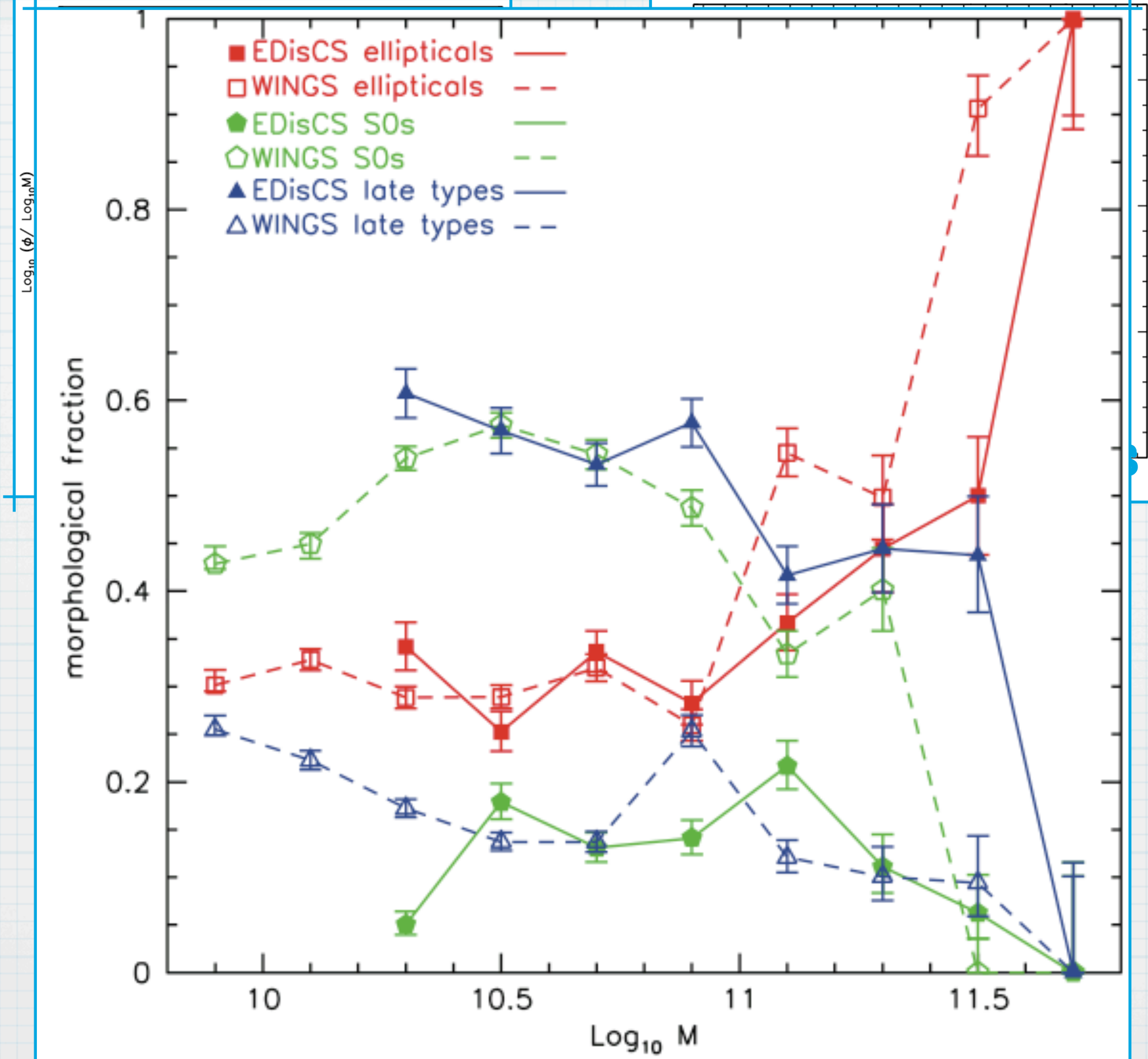
ELLIPTICALS



SOs



LATE-TYPES


EDisCS ellipticals
WINGS ellipticals
EDisCS SOs
WINGS SOs
EDisCS late types
WINGS late types
morphological fraction
Log10 (Φ/ Log10M)
0
0.2
0.4
0.6
0.8
1
10
10.5
11
11.5
Log10 M

What drives the evolution?

* mergers
* harassment
* environmental mass segregation of infalling galaxies
* star formation
* morphological transformation

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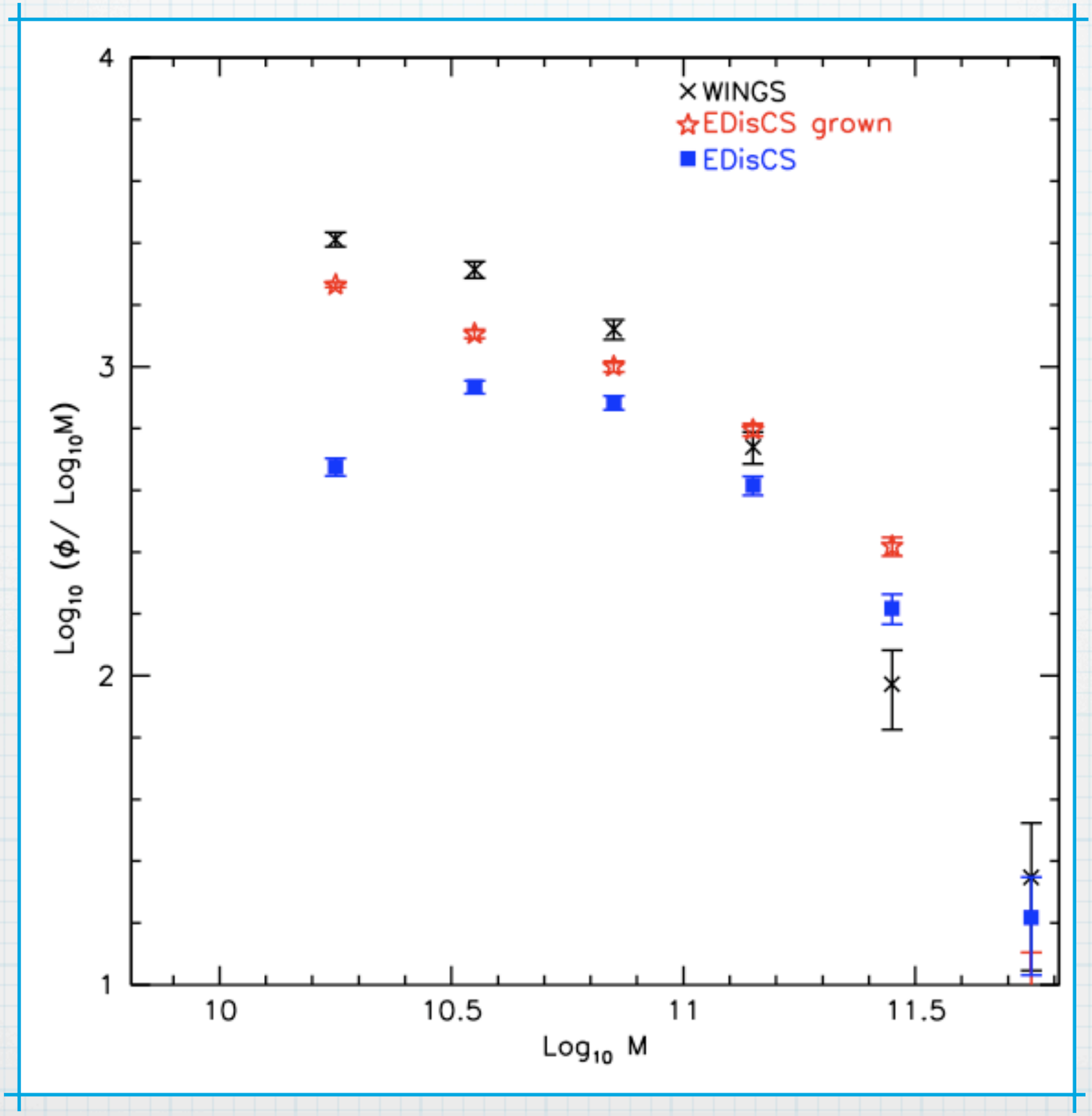

What drives the evolution?

MASS GROWTH OF GALAXIES DUE TO STAR FORMATION IN BOTH CLUSTER GALAXIES AND IN GALAXIES INFALLING FROM THE CLUSTER SURROUNDING AREAS. THIS PROCESS IS ACCOMPANIED ALSO BY THE MORPHOLOGICAL TRANSFORMATION FROM ONE TYPE TO THE OTHER.

The red/blue MF

$$(U-B)_{Vega} \geqslant 1.10 + 0.075 \times \log\left(\frac{M \times 1.12}{10^{10} M_{\odot}}\right) - 0.18 \times z - 0.88(2)$$

Peng+ (2010)

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ICBS - $M_* \geqslant 10^{10.55} M_{\odot}$

	red		blue	
	$\%_{obs}$	$\%_w$	$\%_{obs}$	$\%_w$
cluster regions	71.0±3.6%	72.8±2.5%	29.0±3.6%	27.2±2.5%
cluster outskirts	55.4±3.9%	56.5±2.6%	44.6±3.9%	43.5±2.6%
groups	52.7±5.7%	52.5±3.8%	47.3±5.7%	47.5±3.8%
pure field	38.4±4.2%	38.8±2.6%	61.6±4.2%	61.2±2.6%

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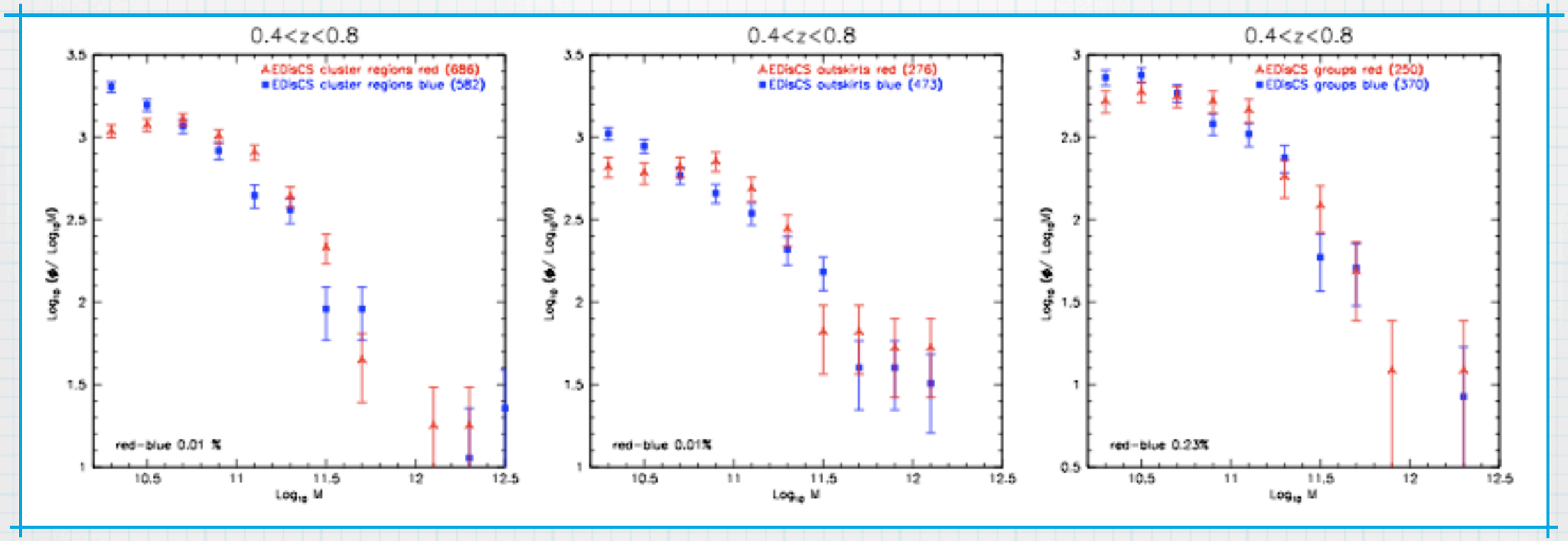
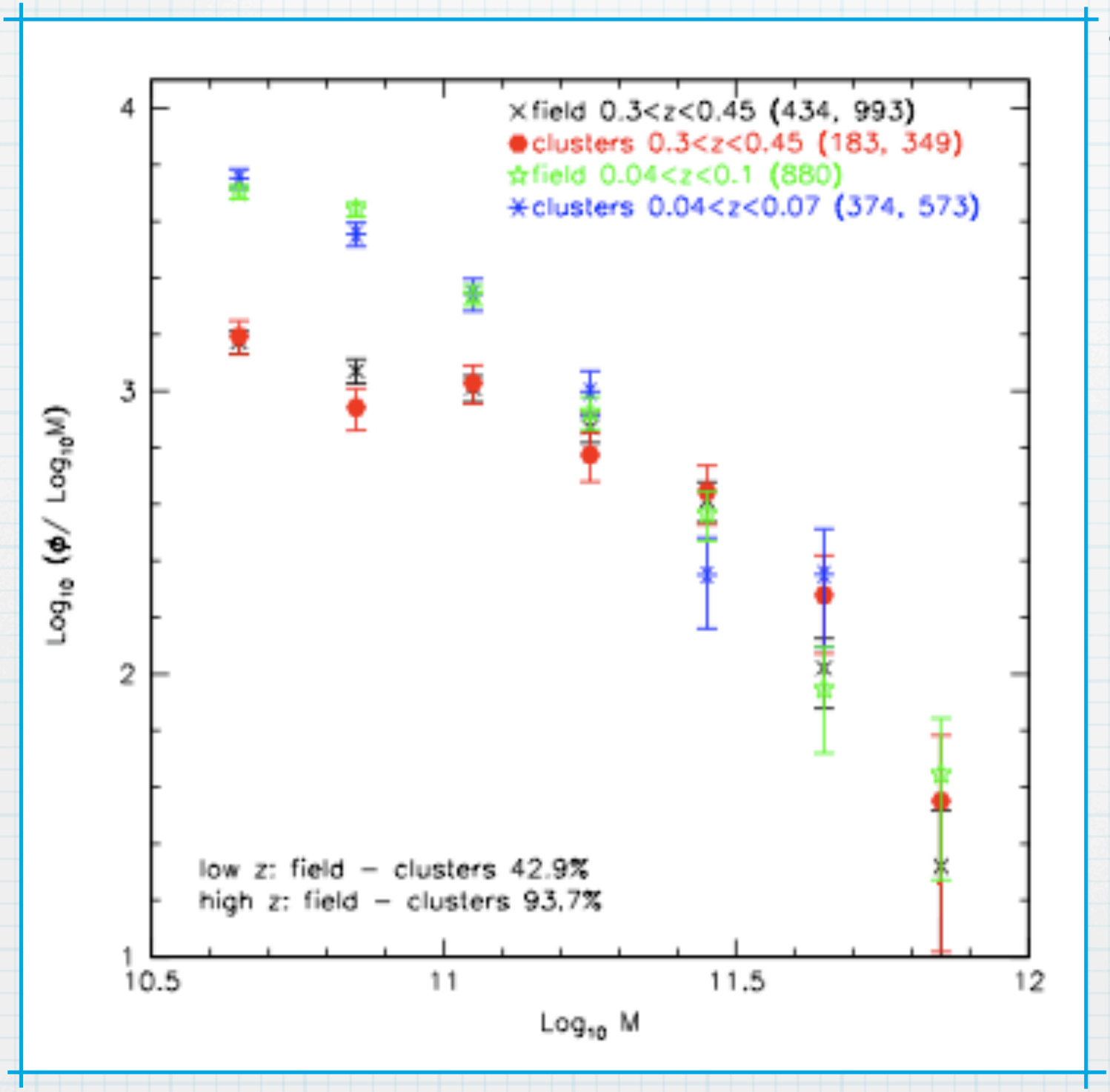


In all environments, red and blue galaxies have different MF

The evolution in different GE

from z~0.4 to z~0



The evolution of the MF with time is independent of environment

field at low-z from PM2GC (Calvi+ in preparation)

SFR-Mass relation in different environments

FIELD: strong correlation between SFR and mass. It shifts to higher SFRs at higher z

(e.g. Noeske et al. 2007a, Elbaz et al. 2007, Daddi et al. 2007)

CLUSTERS?

EDisCS data

SFR for 24 μm detected:

- from IR luminosity (Finn et al. 2009) using Kennicutt (1998)
- from [OII] luminosity (Poggianti et al. 2008)

$$SFR_{tot}=SFR_{IR}+SFR_{[OII]}$$

SFR for galaxies without 24 m detection :

- from [OII] luminosity (Poggianti et al. 2008) dust-corrected

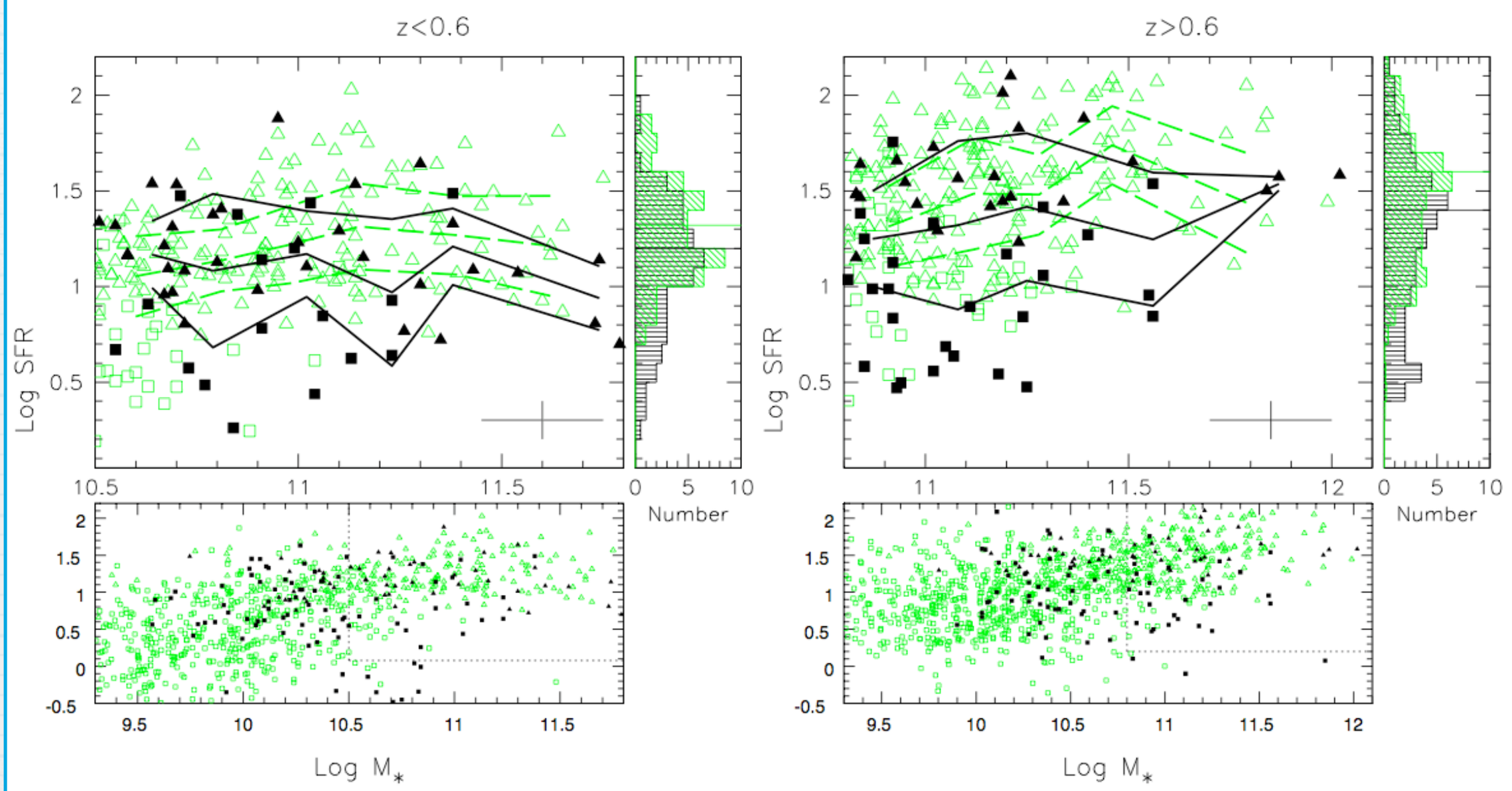
Galaxies without 24 μm detection are divided into red and blue:

$$U-B> -0.032(M_B+21.52)+0.454-0.25$$

AGN contamination?

GROUPS?

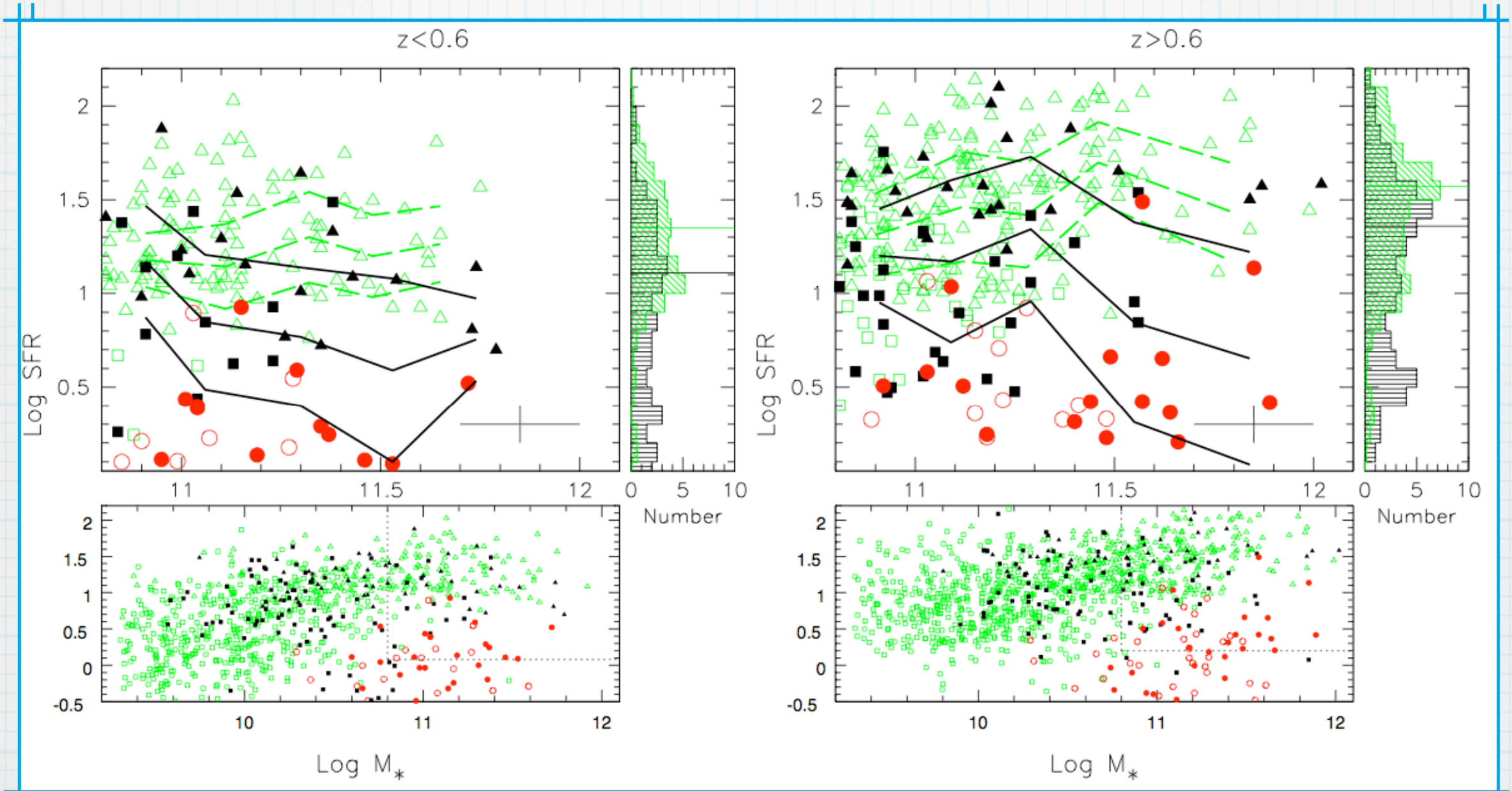
SFR-Mass relation



24 μm + blue emission lines

Delta <SFR>=1.35 +/- 0.15

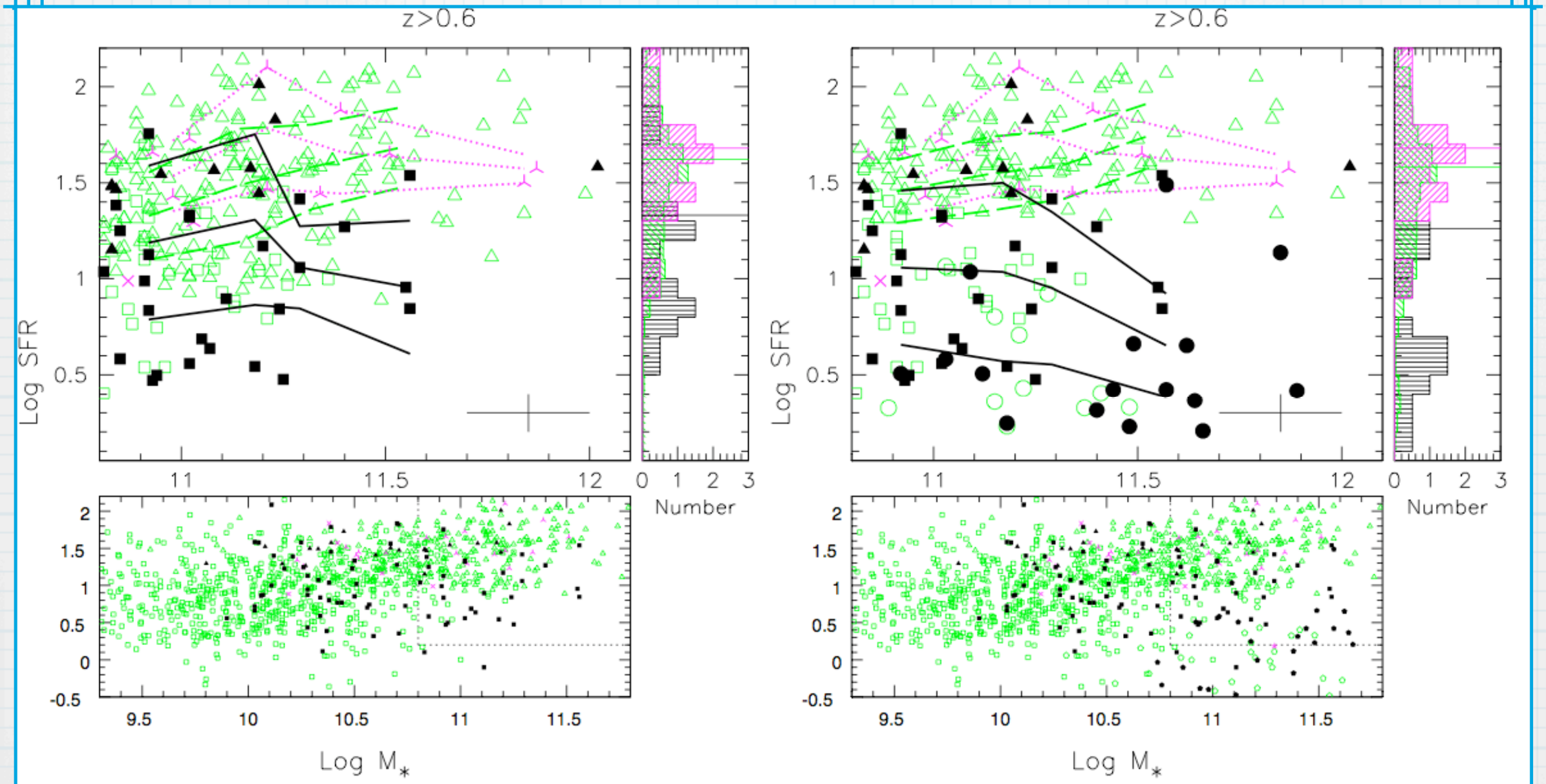
SFR-Mass relation



24 μm + blue and red emission lines

Delta <SFR>=1.63 +/- 0.20

SFR-Mass relation



Clusters, groups, field

Summary (I)

* In clusters, both the total galaxy stellar mass function and that of each morphological type evolve with z. There are proportionally more massive galaxies at high- than at low-z.

* Galaxy in clusters, groups and field follow the same mass distribution. THE GALAXY STELLAR MASS FUNCTION DOES NOT VARY WITH THE GLOBAL ENVIRONMENT AT z=0.3-0.8.

* In all environments, red and blue galaxies are regulated by different MF. Comparing the MF in different environments separately for blue and red galaxies, no differences are detected.

* Comparing the cluster and field MF at high a low z, we find that they evolve in the same way. THE EVOLUTION OF THE MF WITH z IS INDEPENDENT ON ENVIRONMENT

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GALAXY PROPERTIES ARE NOT MUCH DEPENDENT OF CLUSTER MASS... BUT DO DEPEND ON LOCAL SCALE PROCESSES....

Summary (2)

* The relation between SF activity and galaxy mass depends on environment
* There are significant differences between the SF activity of star-forming galaxies of the same mass in different environments.
* Clusters show a lower SF activity than the field, not only because they have a pre-existing large population of early-type galaxies passively evolving since high z, but because currently star-forming galaxies host an average lower SFR than their field counterparts of similar mass

thanks for the attention!

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based on

Vulcani et al. 2011a (MNARS, 412 246-268)

Vulcani et al. 2011b (MNRAS, submitted)

Vulcani et al. 2011c (MNRAS, submitted)

Vulcani et al. 2010 (ApjL, 710, 1)