The morphology-mass relation in different environments at low redshift

Rosa Calvi

Collaborators: Poggianti B., Fasano G., Vulcani B. (INAF-OAPD)

November 7/9, 2011- Galaxy Evolution and Environment (GEE2), Milano

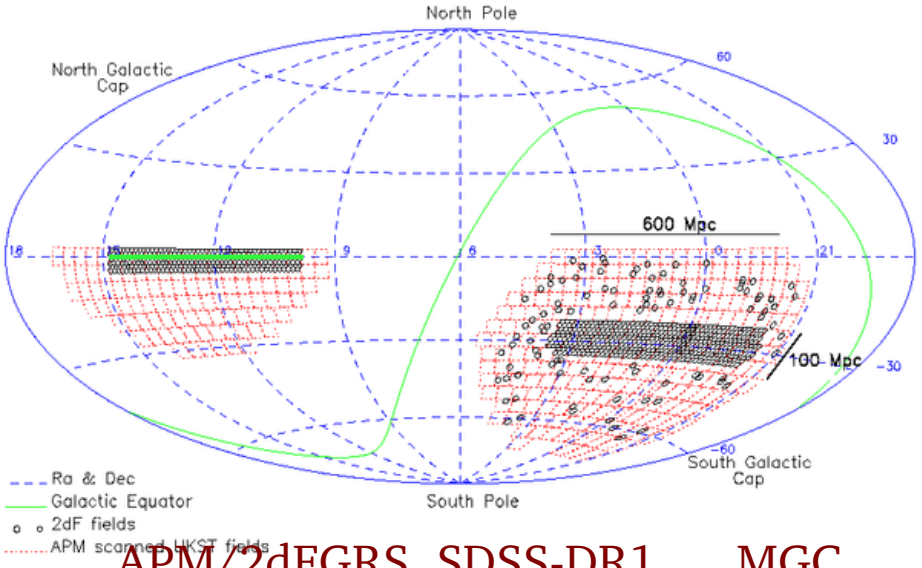
Padova Millennium Galaxy and Group Catalogue (PM2GC)

The Dataset–Millennium Galaxy Catalogue (Liske et al. 2003)

- 144 overlapping fields at $\partial=0$
- 37.5 sq degrees along equatorial strip (10h00m-14h50m)

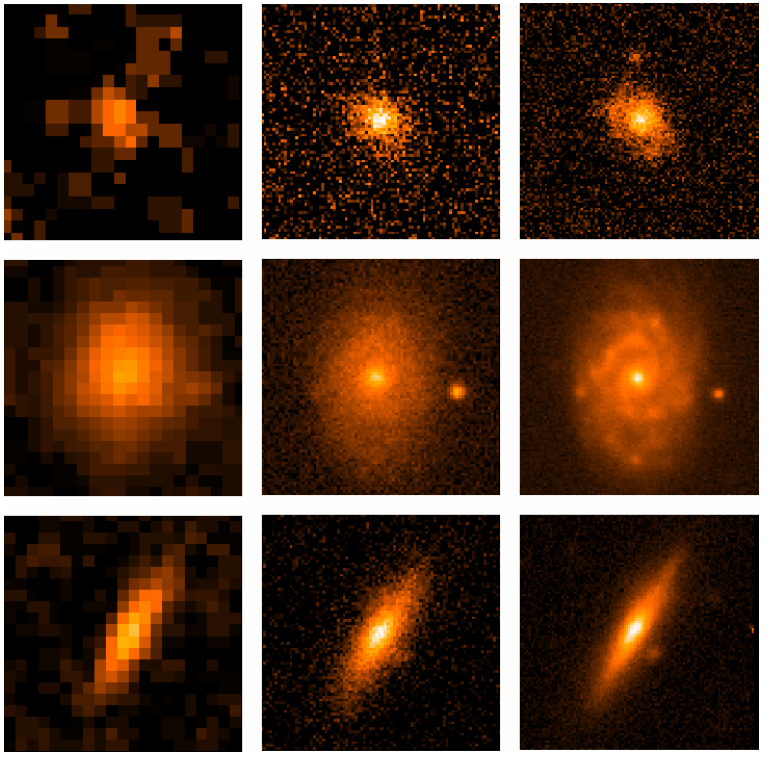
B-band, μ_{lim}= 26mag/s arcsec^2

- INT/WFC 0.333" pixels, FWHM~1.2", median seeing=1.3 arcsec
- 576 individual 2048x4100 CCD images
- Blim= 24 mag



MGC - BRIGHT sample is defined as the ~10000 with 16<B<20 mag

APM/2dFGRS SDSS-DR1 MGC



MGCz survey

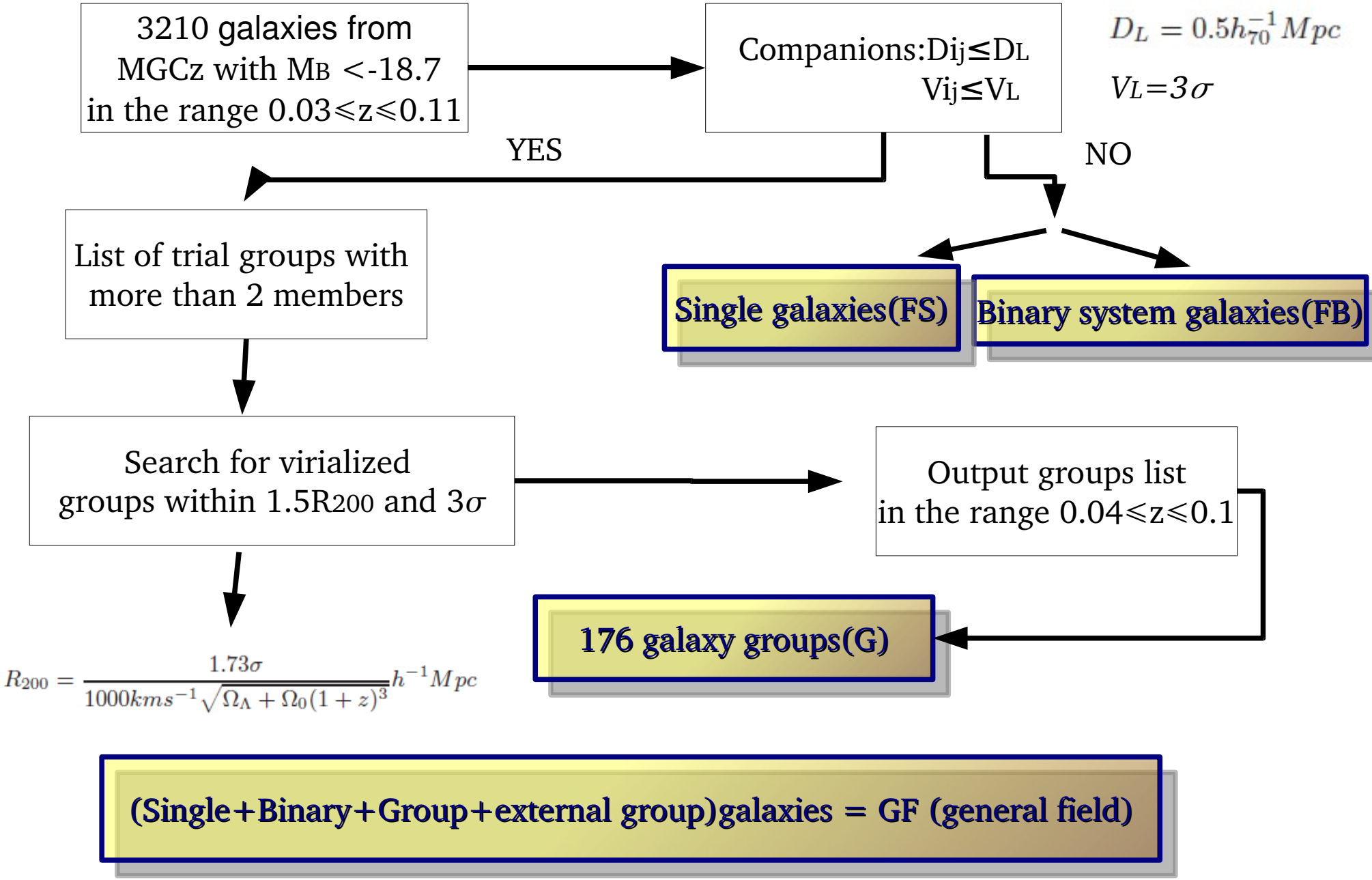
- 2dFGRS
- SDSS
- Others

+

- NTT
- TNG
- GEMINI
- RSAA 2.3m

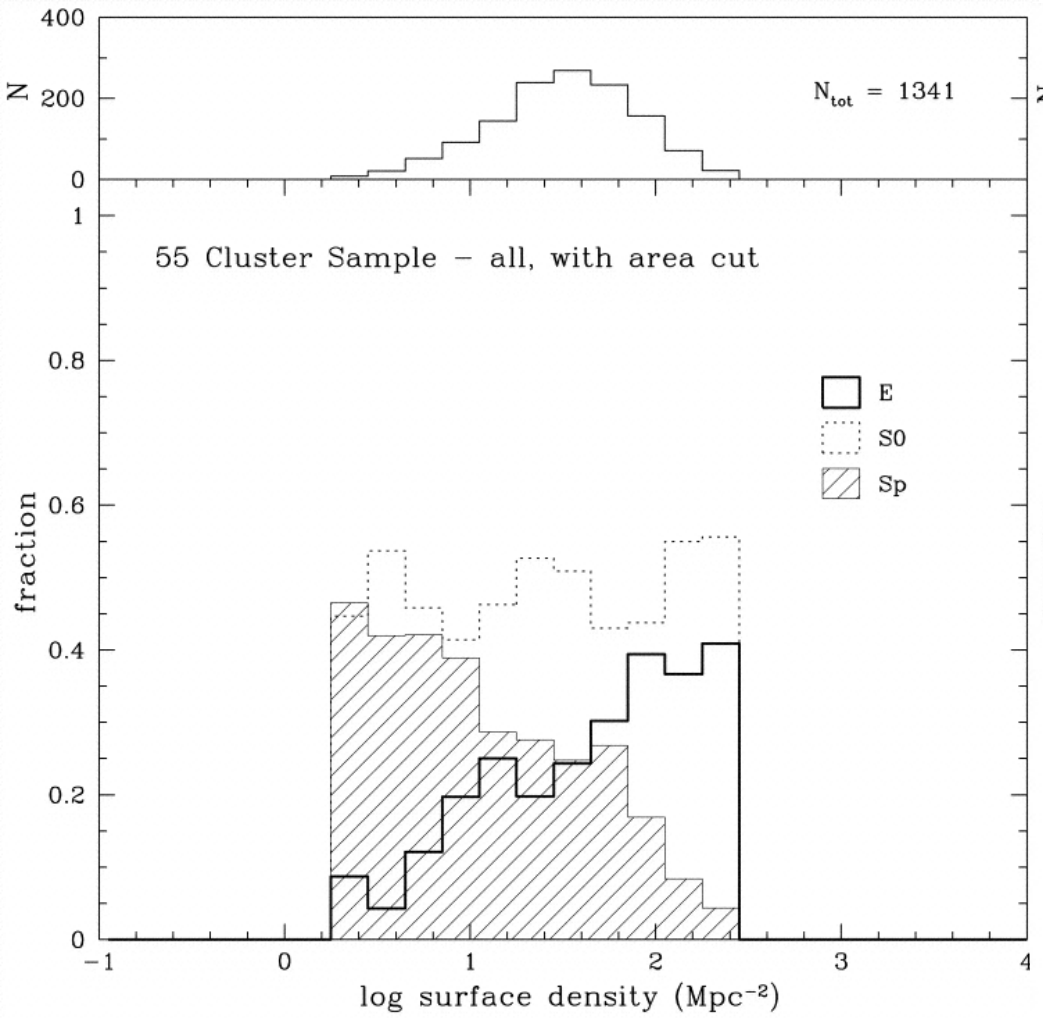
96.05% spectroscopic completeness (99.79% Complete to B<19.2)

PM2GC construction: the Group-finding algorithm (FoF) and the galaxy catalogues of Single, Binary, Group and GF galaxies (Calvi et al. 2011a)

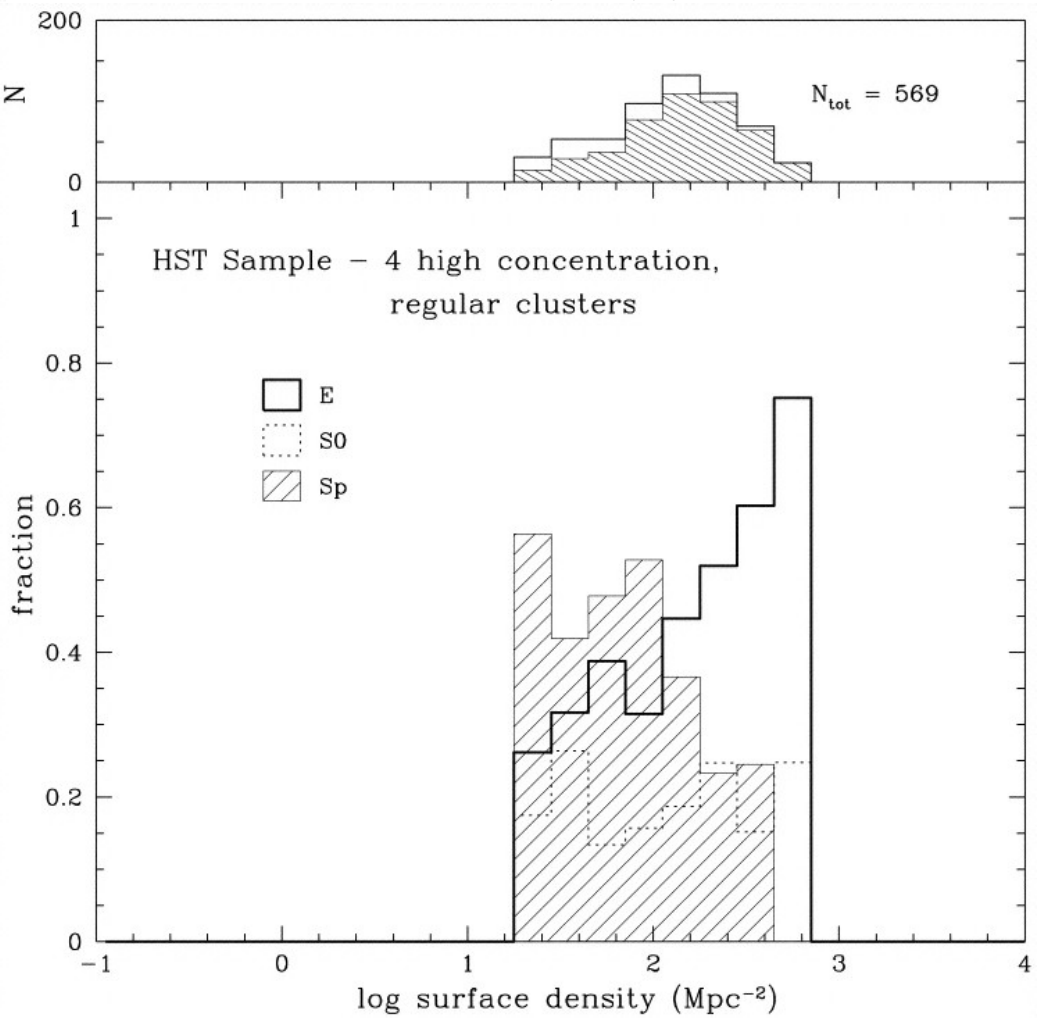


Evolution of the Morphology-Density relation in clusters

z=0

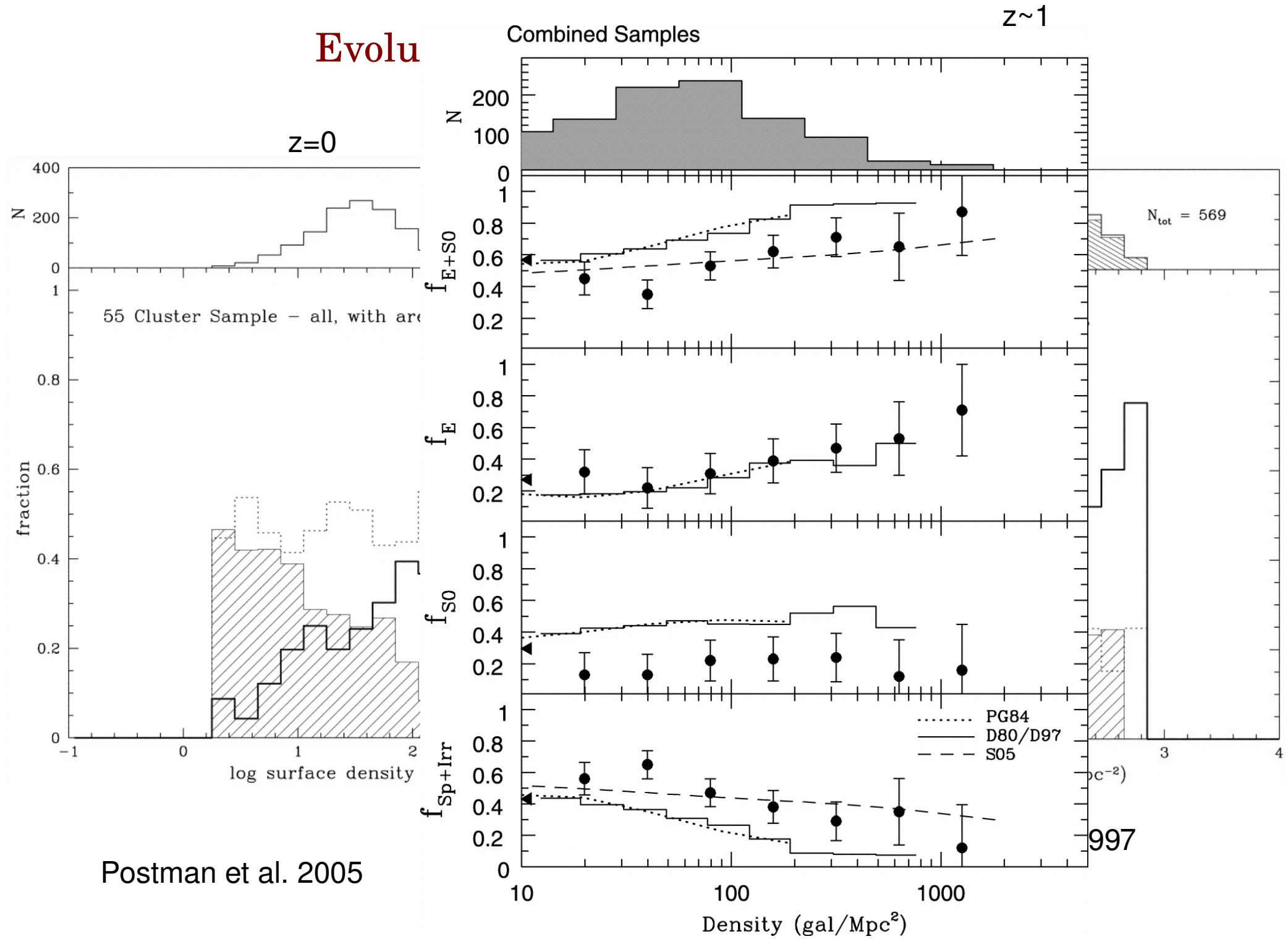


z=0.4-0.5



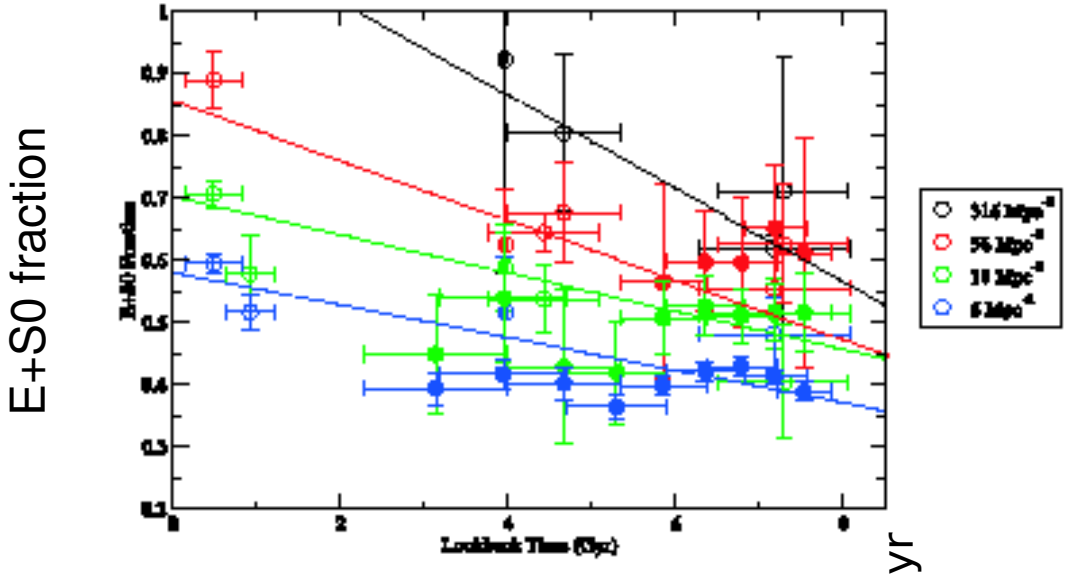
Dressler et al. 1997

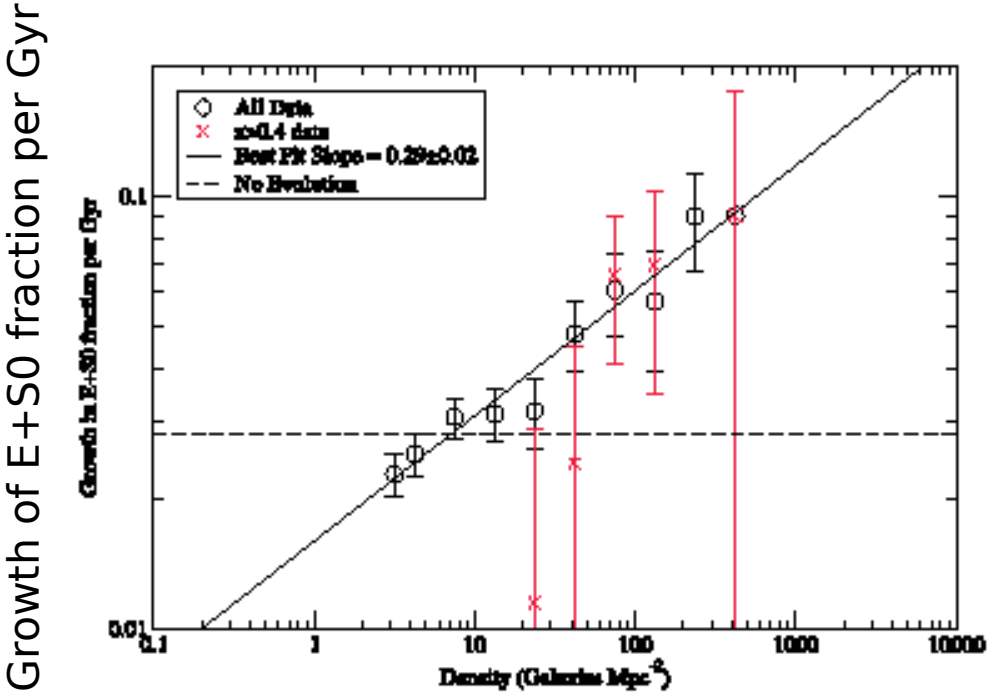
Evolu



Postman et al. 2005

MD relation: evolution in the field

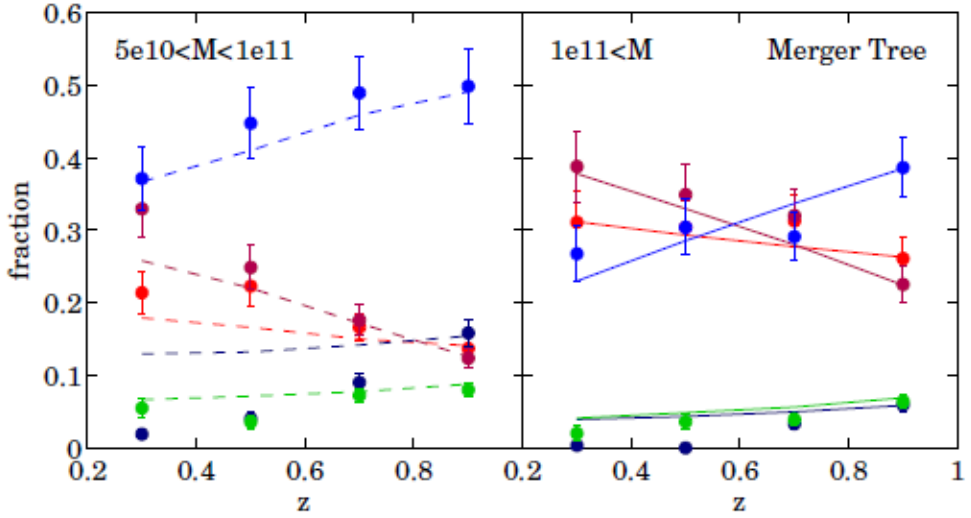




- The rate of elliptical formation increases with increased density.
- There is the lack of evolution at z > 0.4 in the lowest two density bins.
- The growth rate of the early-type fraction is increasing with density.

Capak et al. 2007

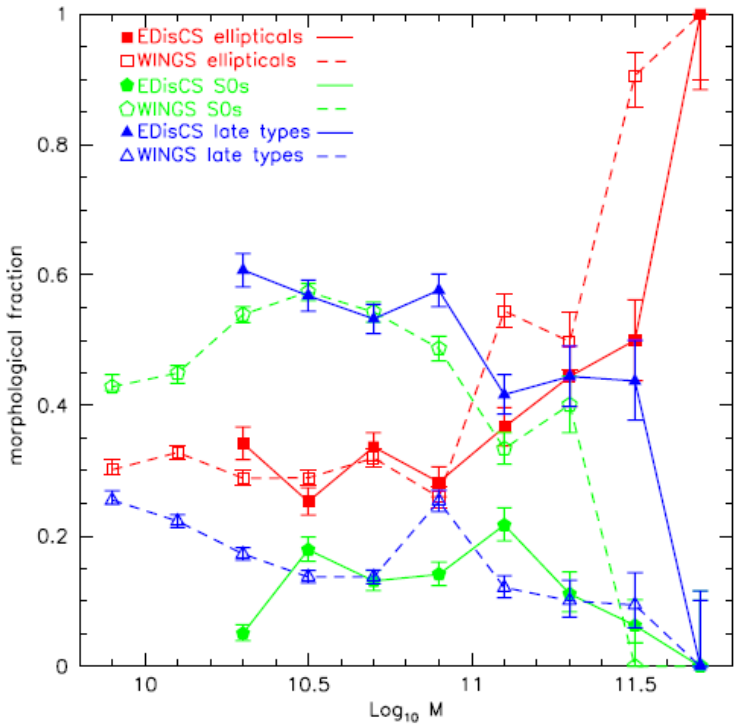
Morphological evolution and mass in the field



Ellipticals
intermediate spirals
bulge-dominated disk
bulge-less disk
irregulars

Oesch et al 2010

and in clusters



Vulcani et al. 2011

Morphological evolution is strongest in low-mass than in massive clusters (Poggianti et al. 2009; Wilman et al. 2009; Just et al. 2010)

The Hubble type fractions in different environments at low redshift (PM2GC and WINGS)

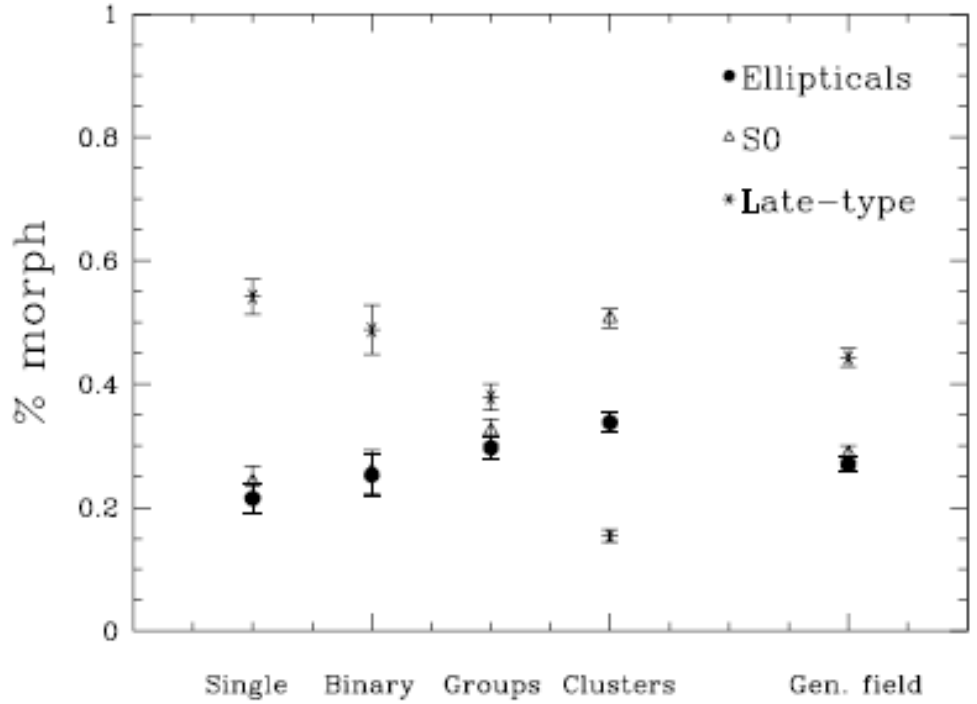
MORPHOT tool for morphological classification (Fasano et al. 2011)

$$M_\star \geqslant 10^{10.25} M_\odot$$

$0.04 \leqslant z \leqslant 0.1$ for PM2GC

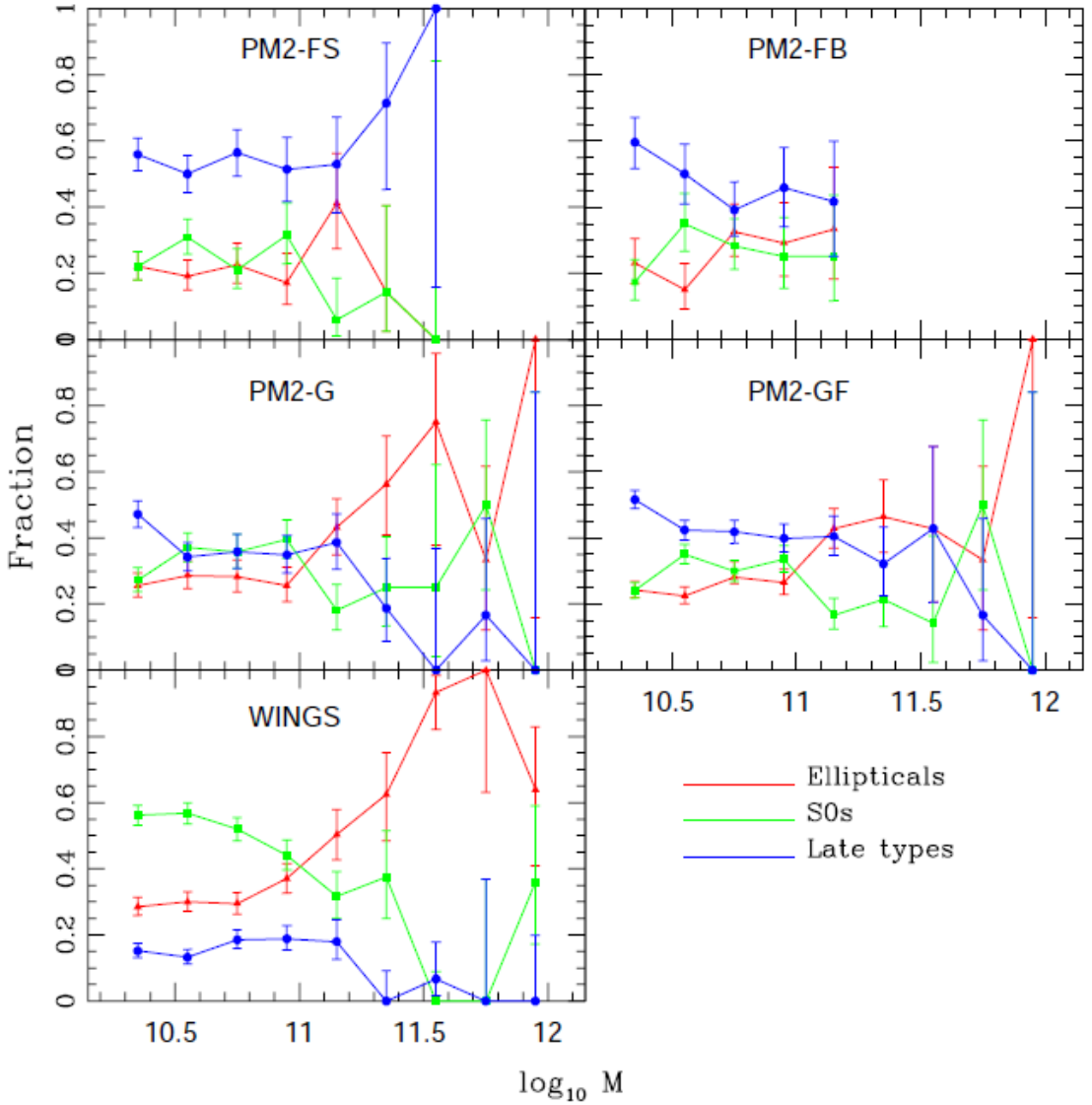
$0.04 < z < 0.07$ for WINGS

Envir.	N. of gal.	Galaxy type			
		Ellipticals	S0s	Late-type	Early-type
WINGS	690 (1056.12)	33.8±1.5%	50.7±1.5%	15.4±1.0%	84.5±1.0%
PM2-GF	1188	27.0±1.3%	28.7±1.3%	44.3±1.5%	55.7±1.5%
PM2-G	583	29.7±1.9%	32.4±2.0%	37.9±2.1%	62.1±2.5%
PM2-FB	174	25.3±3.5%	25.8±3.6%	48.8±4.0%	51.1±4.0%
PM2-FS	334	21.5±2.3%	24.2±2.5%	54.2±2.8%	45.7±3.0%



Calvi et al. 2011

Morphology-Mass relation: fixed environment



Mass esimates derived from Bell & deJong relation (2001)

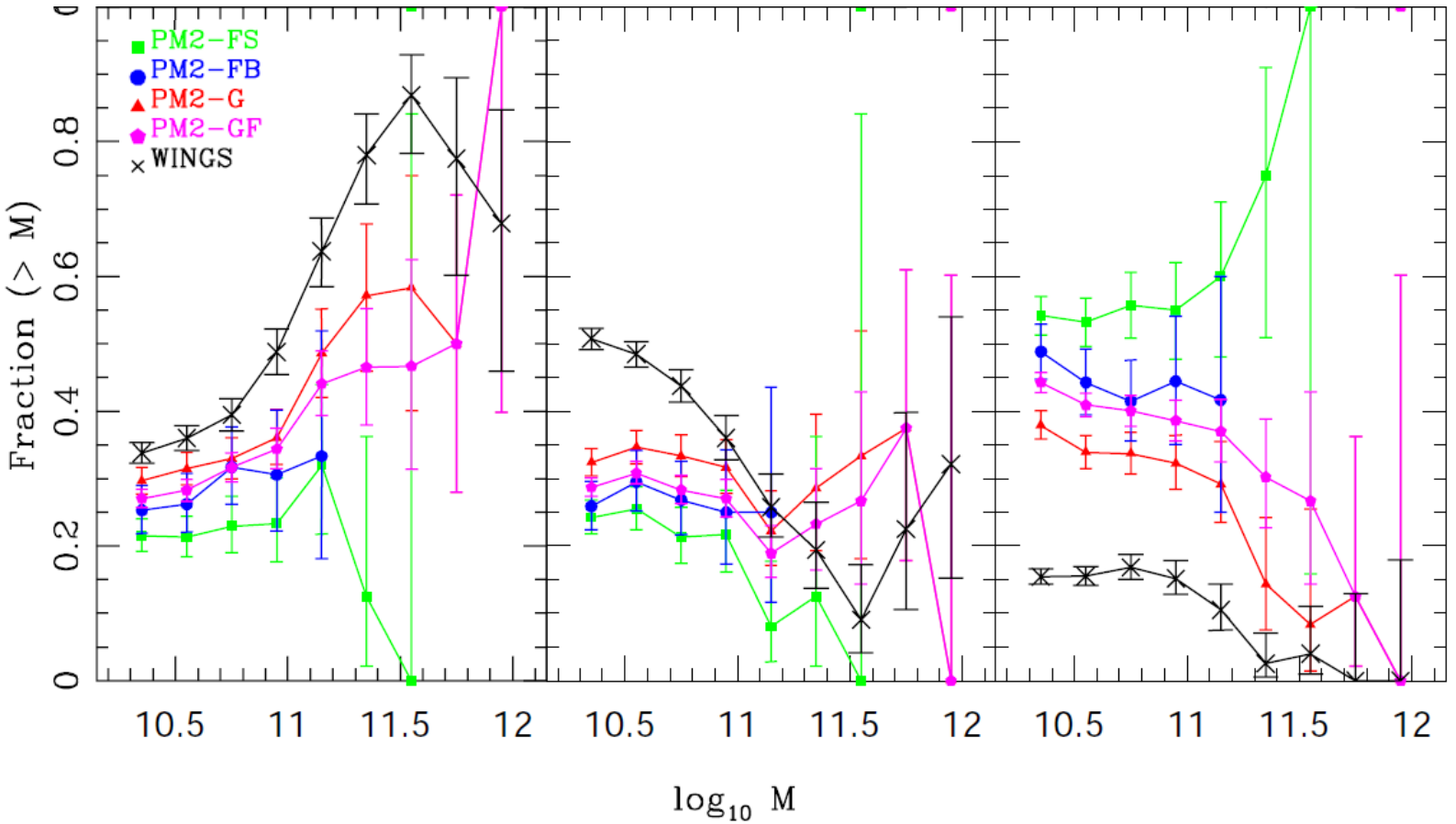
$$\log_{10}(M_\star/L) = a_\lambda + b_\lambda Color$$

Calvi et al. 2011

Morphology-Mass relation: fixed morphological type

Cumulative distributions

Ells S0s Late-types



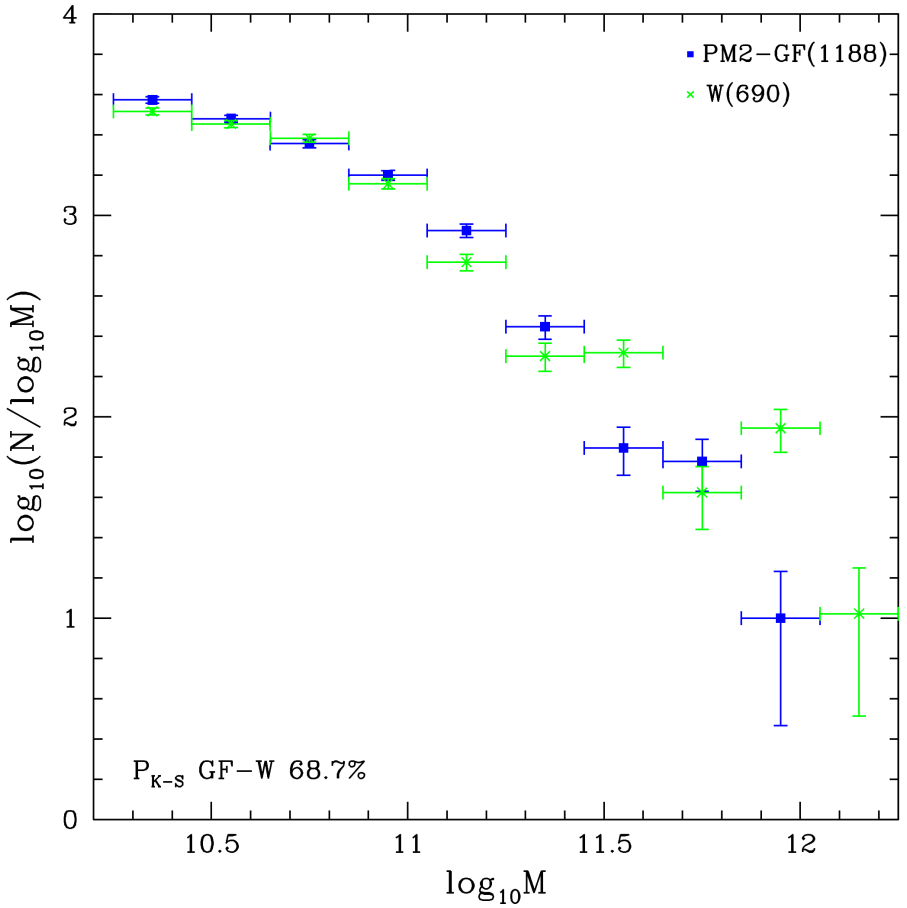
Calvi et al. 2011

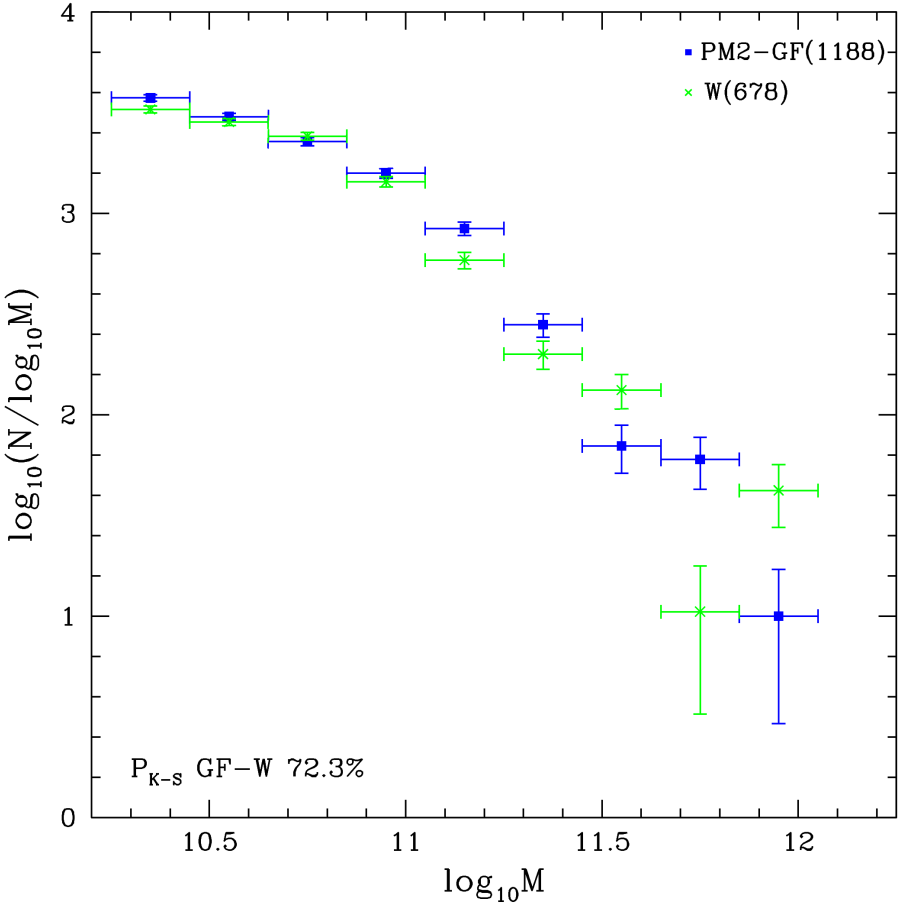
Conclusions

- It is observed a smooth increase/decline in the fraction of Es-S0s/late type galaxies going from single galaxies, to binaries, to groups, to clusters. Considering all environments, the fractional variation is more conspicuous for S0s and late-types than for ellipticals, due to a sharp enhancement/dearth of S0s/late-types in clusters compared to other environments.
- In all environments the morphological fractions strongly depend on galaxy stellar mass only for masses above $\log_{10} M\star/M\odot \sim 11$ (10.8 in clusters), while they are weakly dependent of mass at $10.25 < \log_{10} M\star/M\odot < 11$. At high galaxy masses, the dominant type changes with global environment (elliptical in clusters and groups, late-type in single galaxies).
- The variation of the morphology-mass relation with environment is much more pronounced at $\log_{10} M\star/M\odot > 11$, especially for ellipticals and late-types, while at lower masses there is relatively little change from one environment to the other, except for clusters.
- The morphology-mass relations for cluster S0s and late-types remarkably differ from the corresponding relations in all other environments. These findings strongly suggest that cluster-specific effect act on these two types of galaxies, and that a significant number of S0s in clusters has a different origin with respect to S0s in other environments.

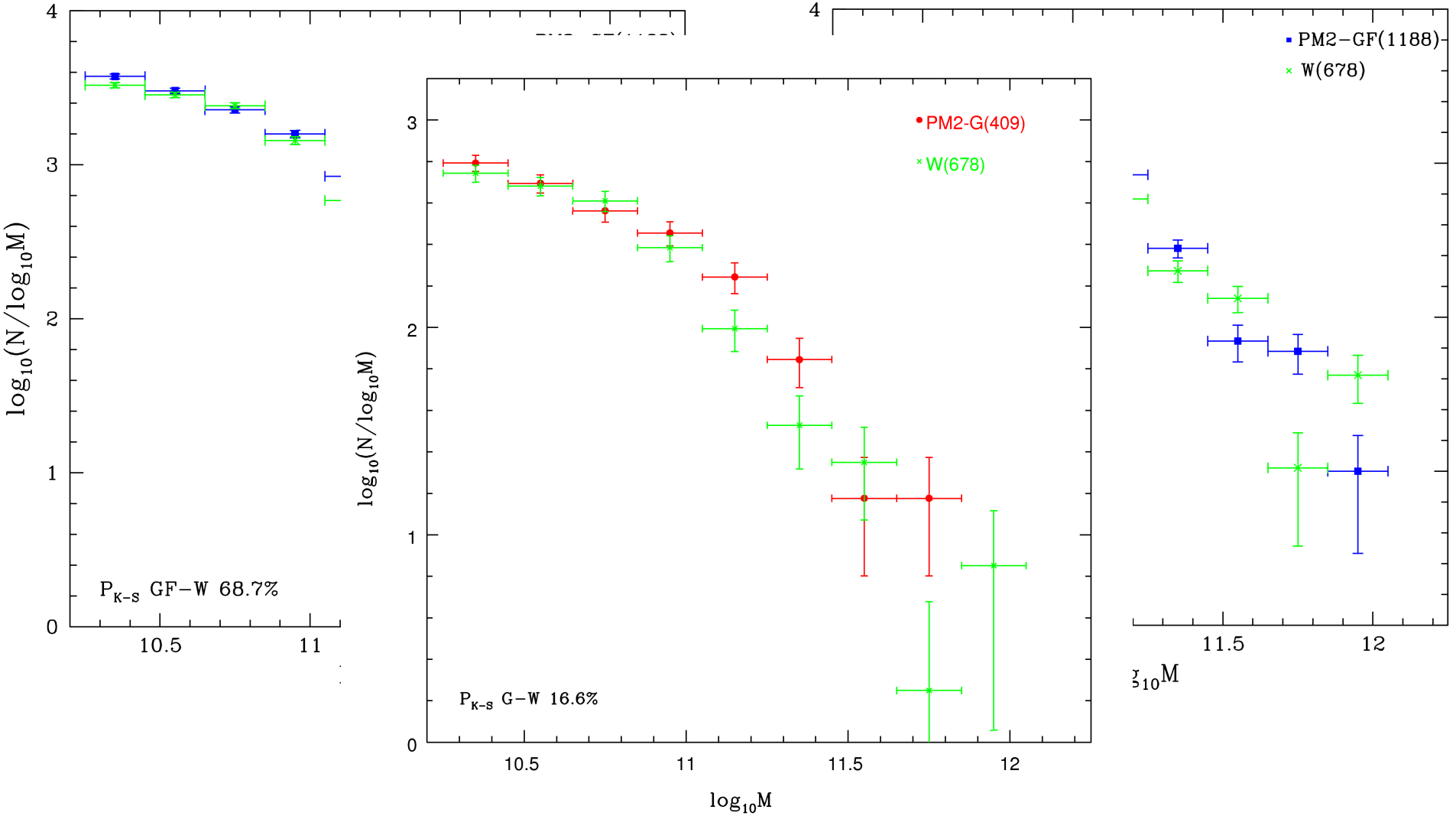
These results show that the morphology-mass relation changes with global environment and that galaxy stellar mass cannot be the only parameter driving the morphological distribution of galaxies.

Work in progress...(Calvi et al. in prep.)





Work in progress...(Calvi et al. in prep.)

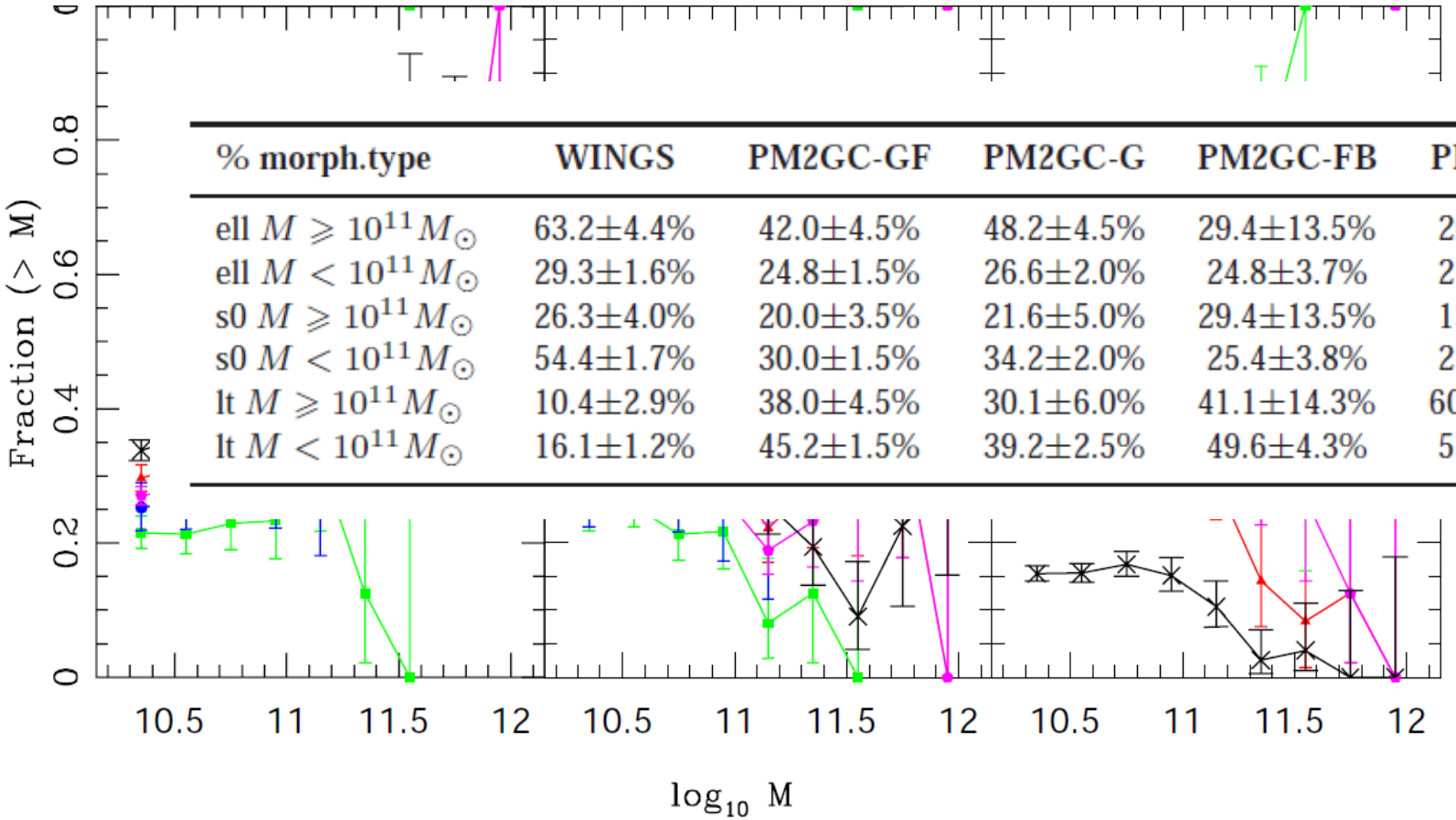


Thank you

Morphology-Mass relation: fixed morphological type

Cumulative distributions

Ells S0s Late-types



% morph.type	WINGS	PM2GC-GF	PM2GC-G	PM2GC-FB	PM2GC-FS
ell $M \geqslant 10^{11} M_{\odot}$	63.2±4.4%	42.0±4.5%	48.2±4.5%	29.4±13.5%	26.6±9.6%
ell $M < 10^{11} M_{\odot}$	29.3±1.6%	24.8±1.5%	26.6±2.0%	24.8±3.7%	21.0±2.5%
s0 $M \geqslant 10^{11} M_{\odot}$	26.3±4.0%	20.0±3.5%	21.6±5.0%	29.4±13.5%	13.3±7.8%
s0 $M < 10^{11} M_{\odot}$	54.4±1.7%	30.0±1.5%	34.2±2.0%	25.4±3.8%	25.3±2.6%
lt $M \geqslant 10^{11} M_{\odot}$	10.4±2.9%	38.0±4.5%	30.1±6.0%	41.1±14.3%	60.0±10.4%
lt $M < 10^{11} M_{\odot}$	16.1±1.2%	45.2±1.5%	39.2±2.5%	49.6±4.3%	53.6±3.0%

Calvi et al. 2011