Evolving galaxies in Evolving Environments

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Galaxy evolution in the VIPERS environment

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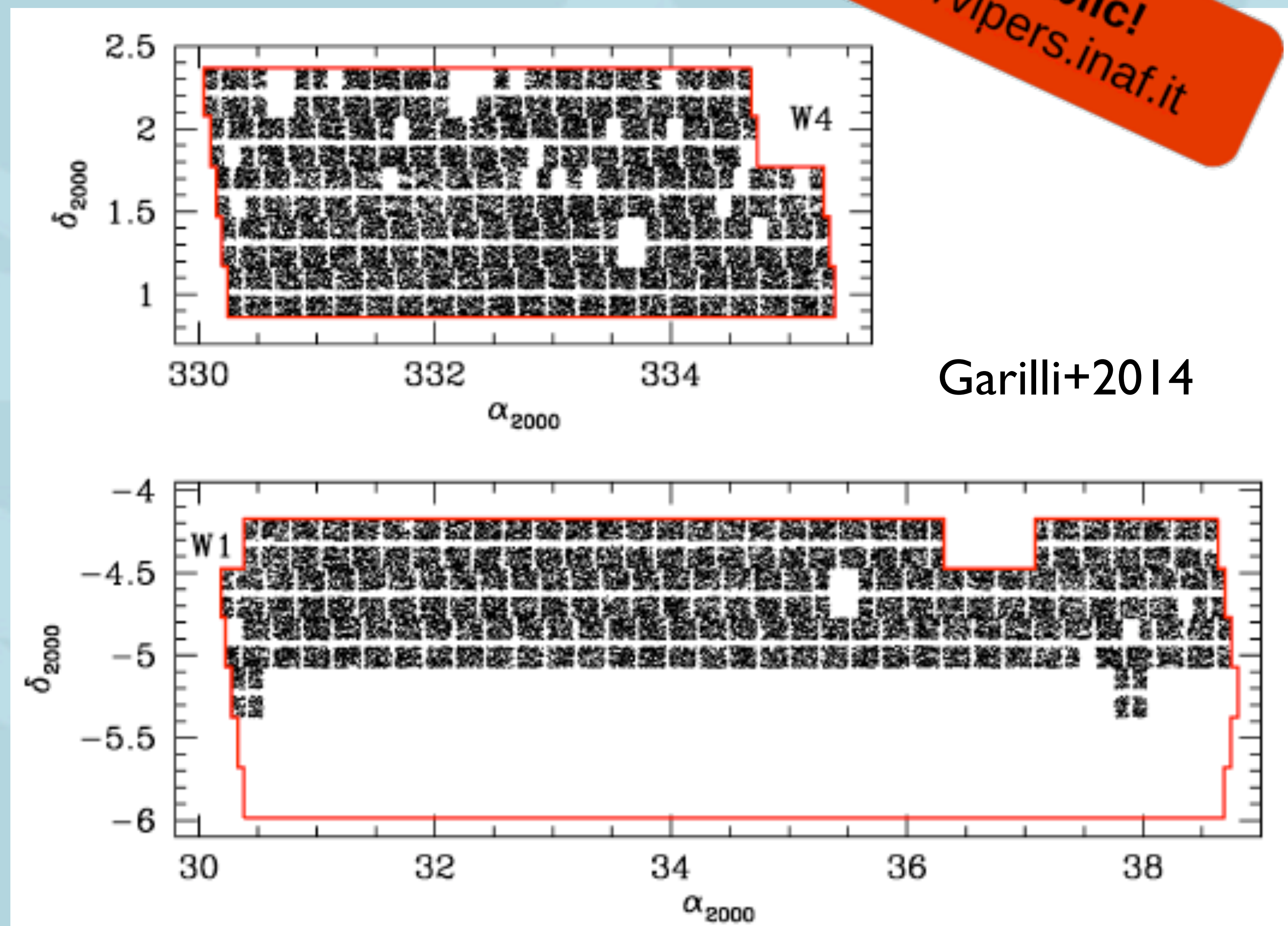
VIPERS in a nutshell

<u>First data release (PDR1)</u>

It's public!
http://vipers.inaf.it

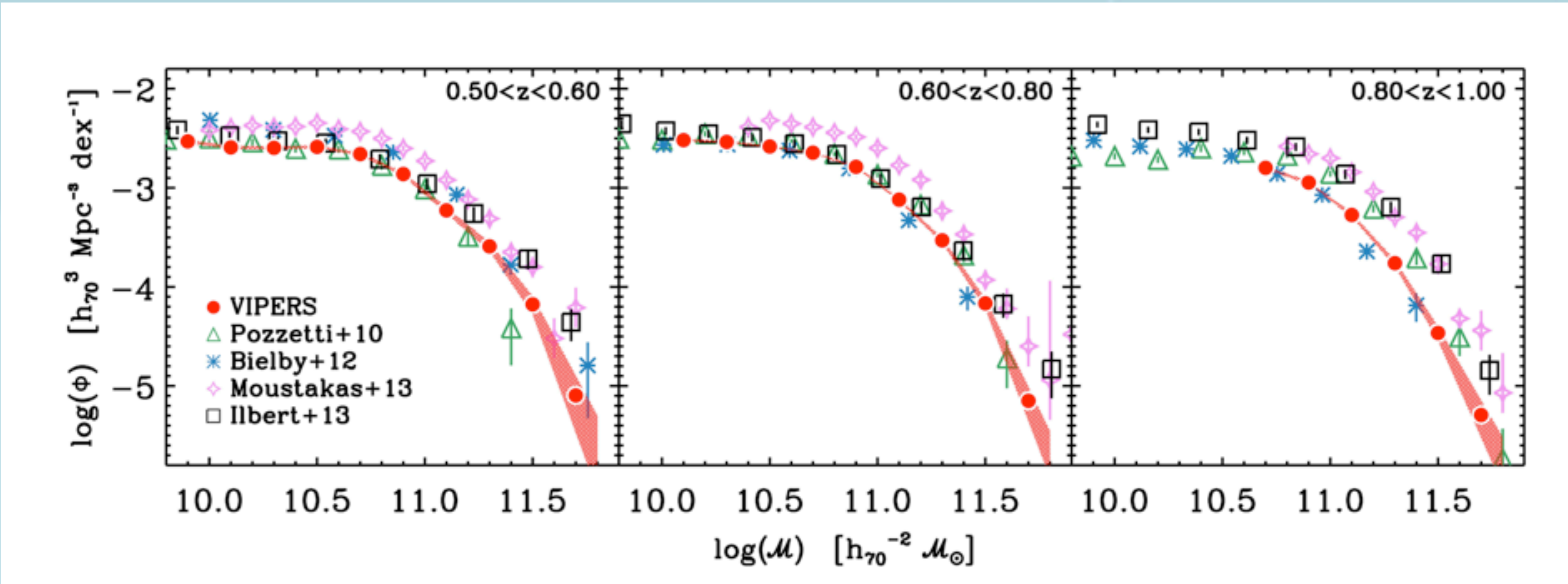
- 53,927 objects
- $0.5 < z < 1.2$
- $i \leqslant 22.5$
- 16 deg^2
- $\Delta z = 0.00047(1+z)$
- UV-optical-NIR



Garilli+2014

Guzzo+2014, Garilli+2014

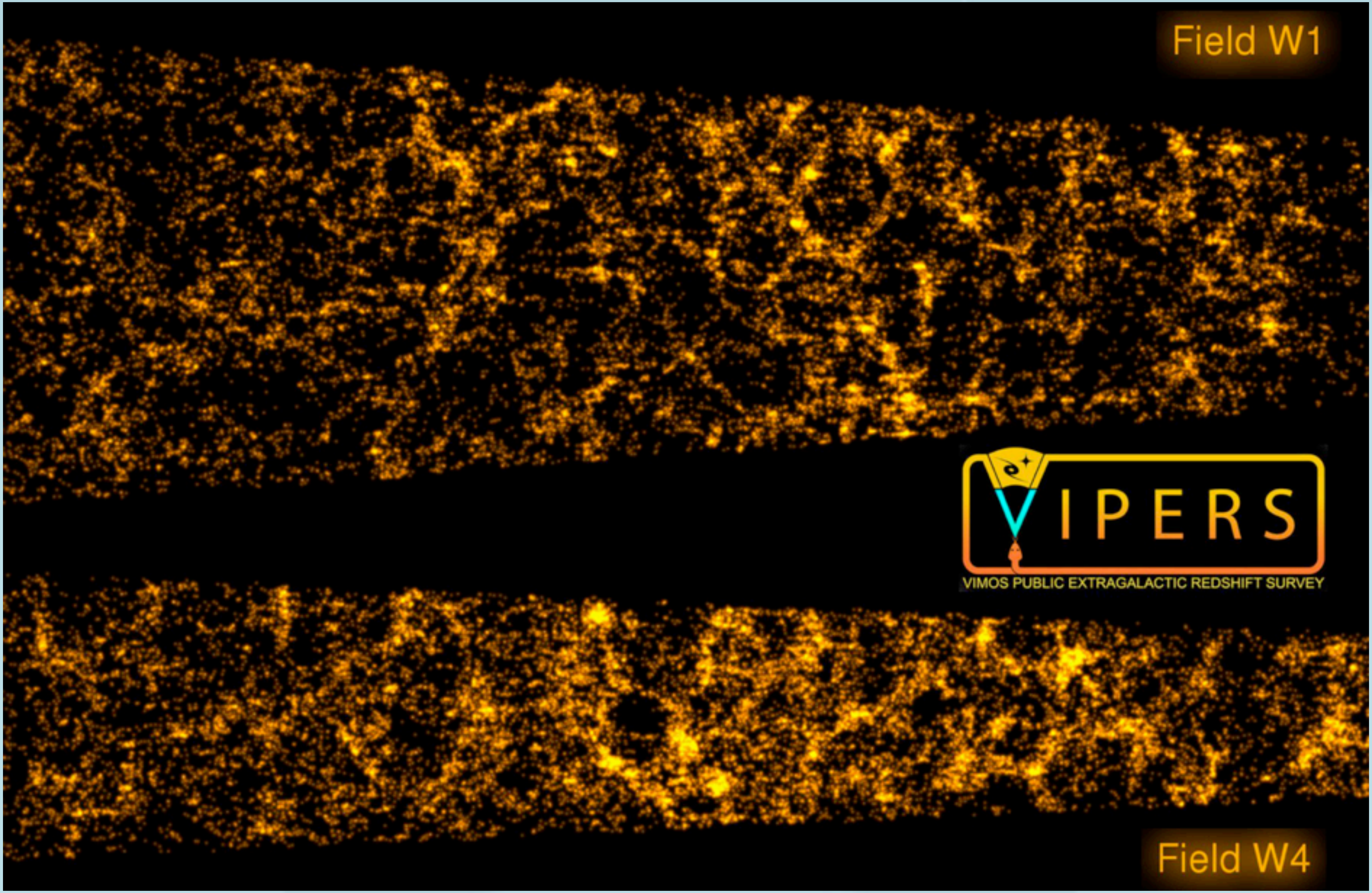
Galaxy stellar mass function (GSMF) of VIPERS PDR1



- more statistical power than previous spectroscopic surveys (e.g. zCOSMOS)
- and less cosmic variance

But... what about the environment?

An excellent laboratory at z~0.8



Environment definition via density contrast

$$\delta(r, R) = \frac{\rho(r, R) - \bar{\rho}(r)}{\bar{\rho}(r)}$$

Cucciati+2014, A&A..565..A67
Cucciati et al. 2014, in prep.

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- R → 5th NN; depth ±1000 km/s
- 2-8 Mpc/h scales

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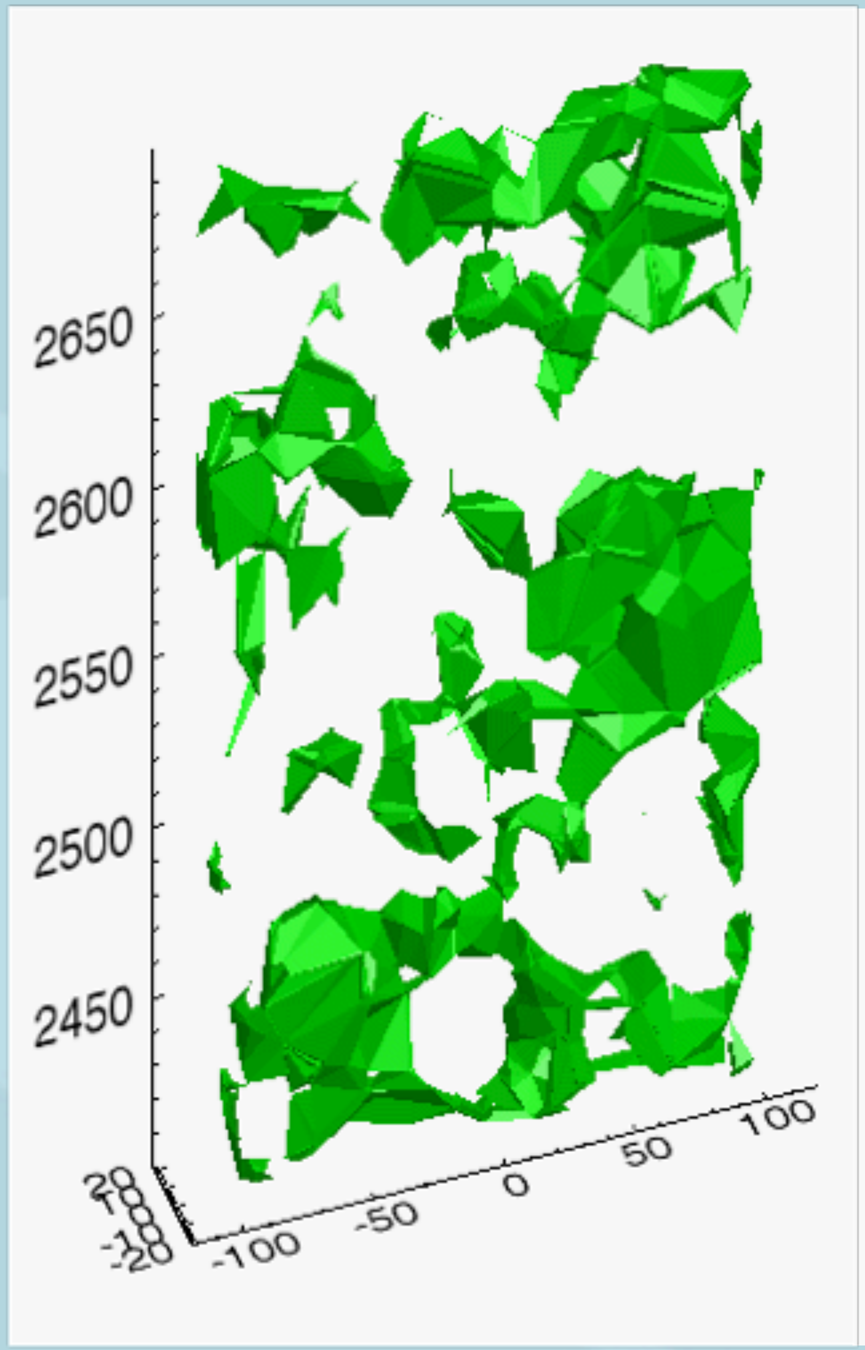

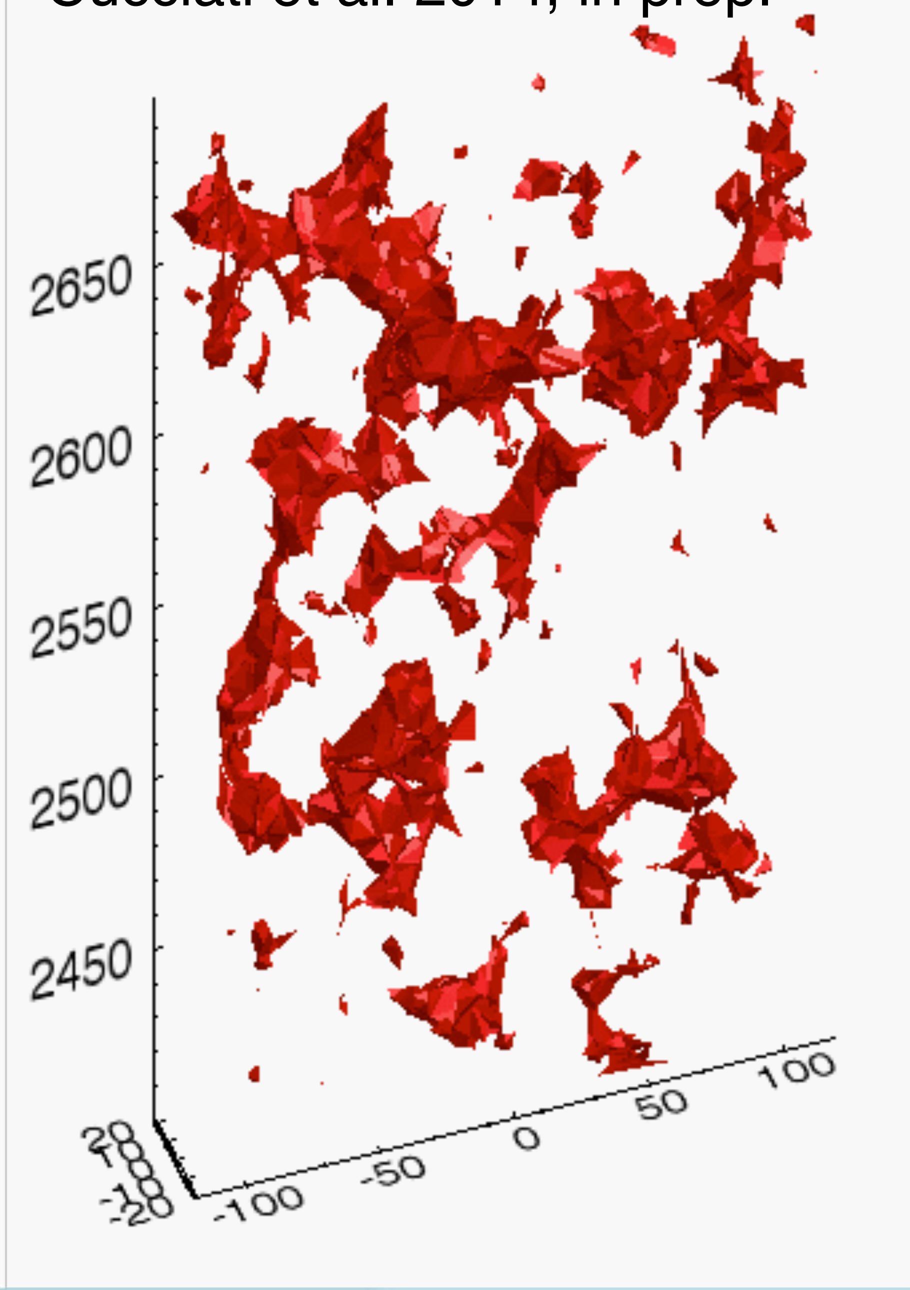

Low density (LD)
galaxies with δ < 0.7

High density (HD)
galaxies with δ > 4

Does the GSMF shape change as a function of the environment?

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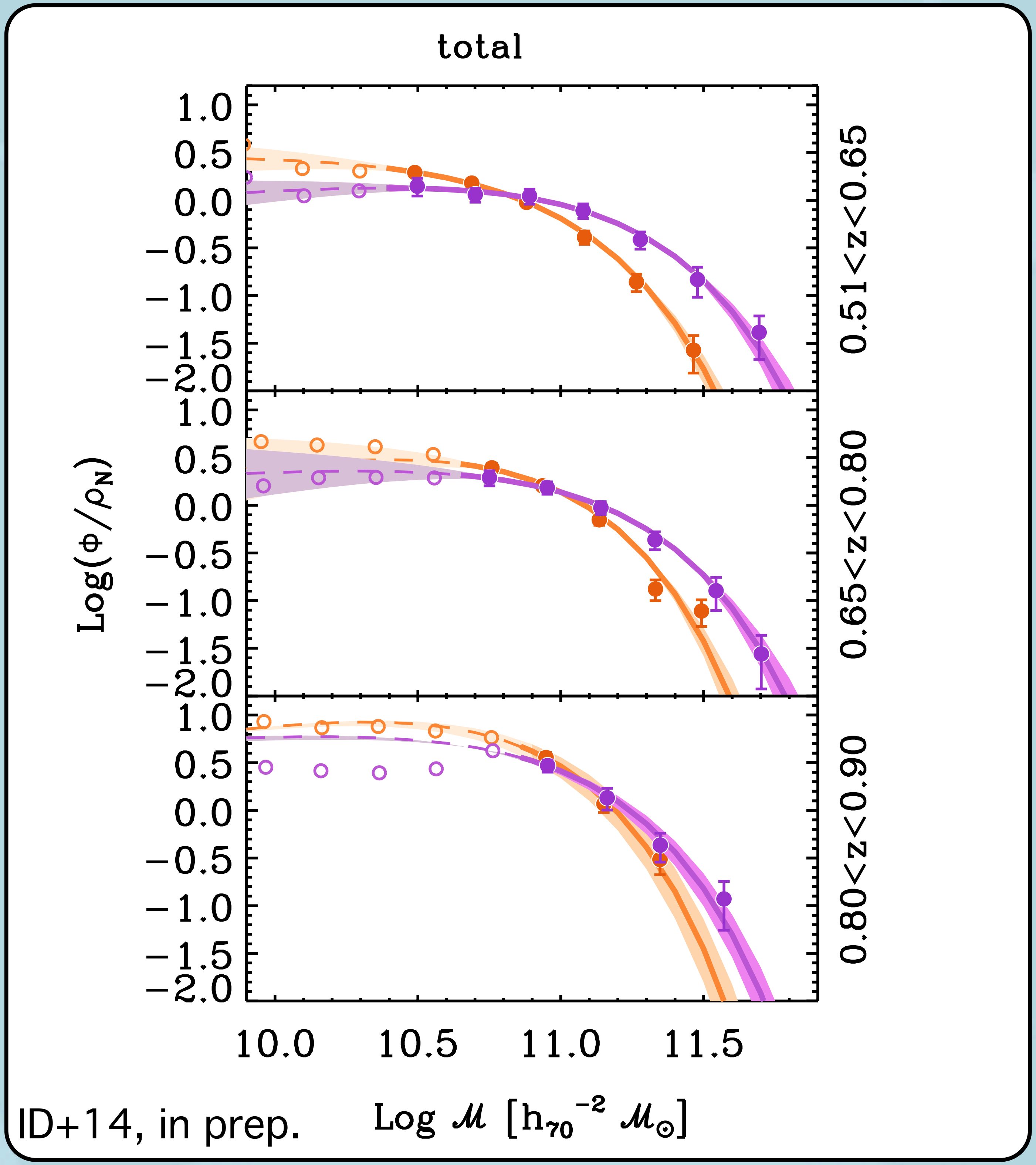
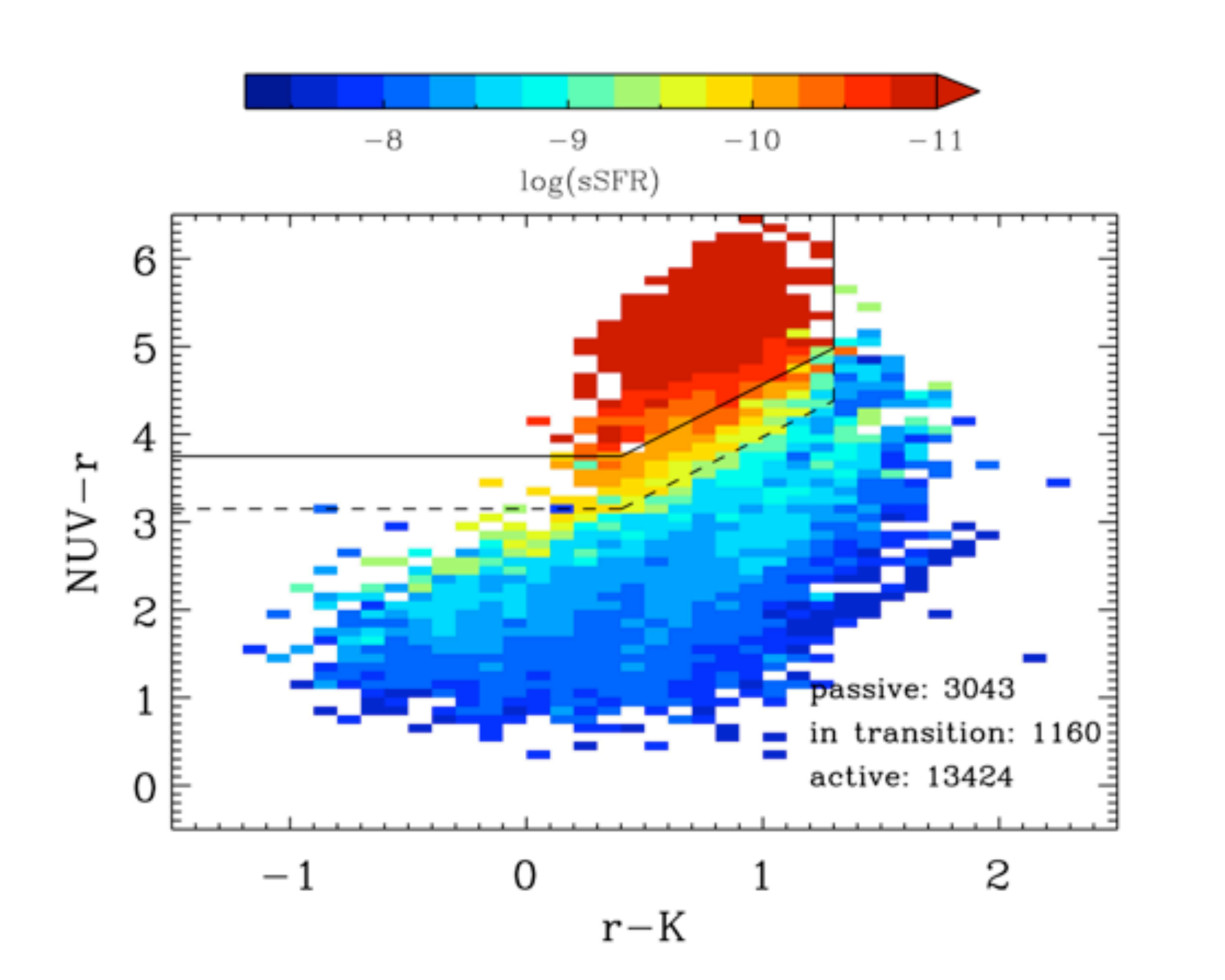
High density

Low density



V_{max} points and STY fit by means of ALF (Ilbert+05)

Galaxy type classification



NUV-r-K diagram (Arnouts+2013)

three galaxy types:

passive

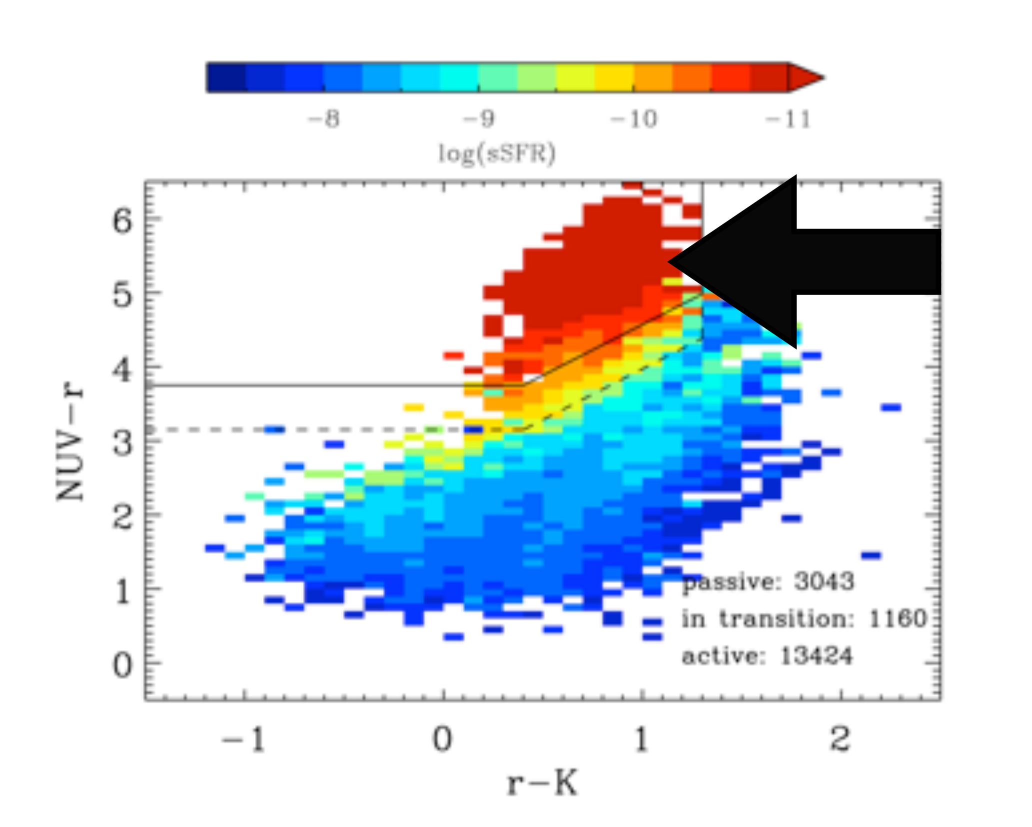
“green valley”

active

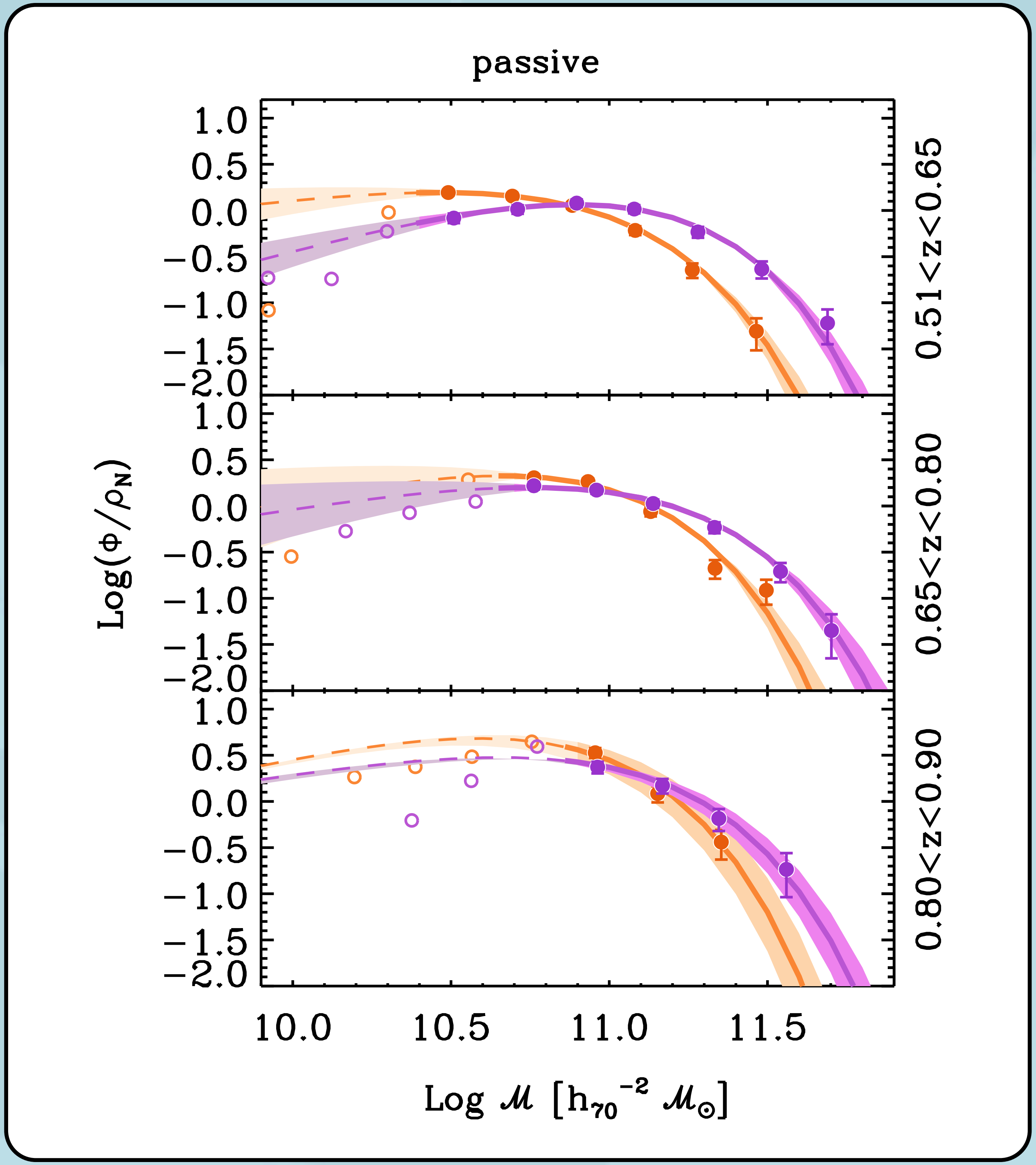
Shape of the passive GSMF

High density

Low density



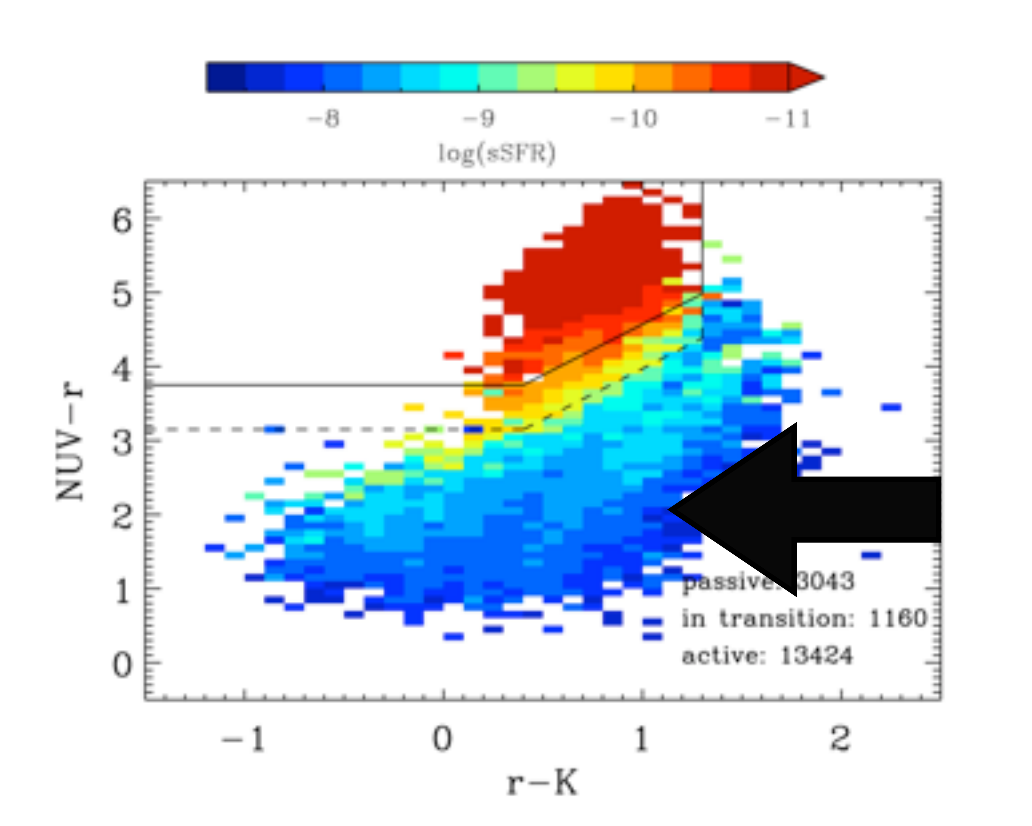
passive



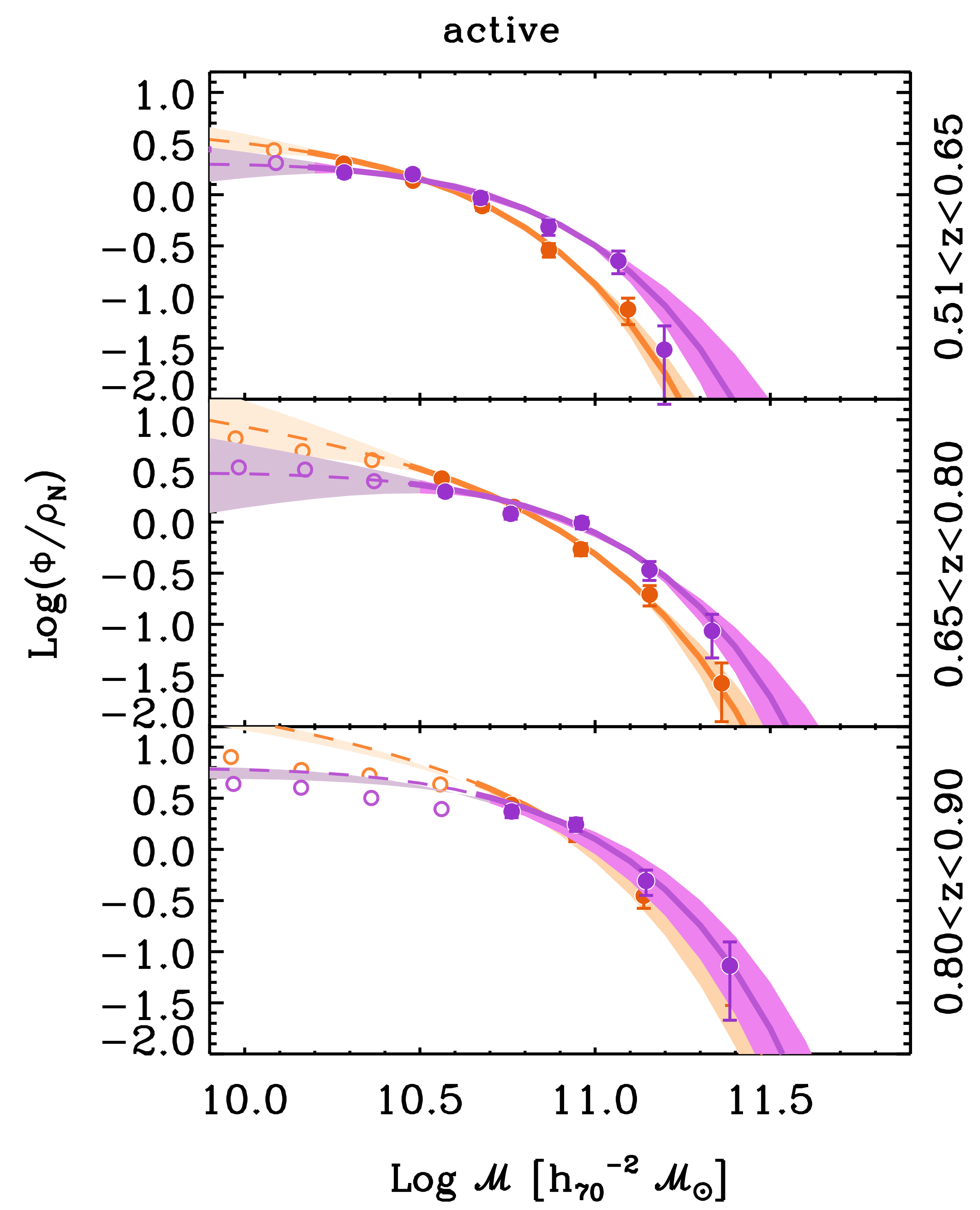
Shape of the active GSMF

High density

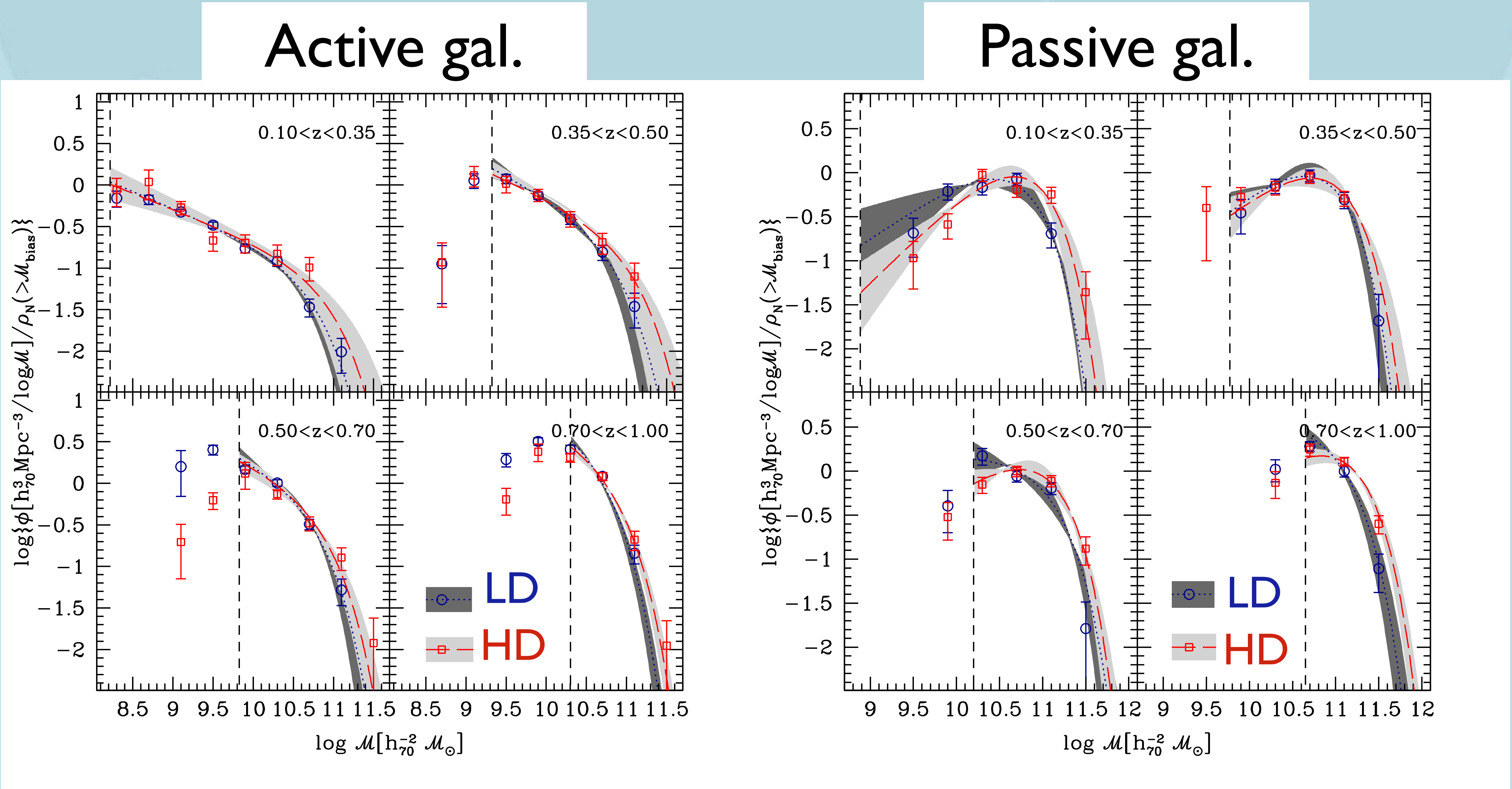
Low density



active



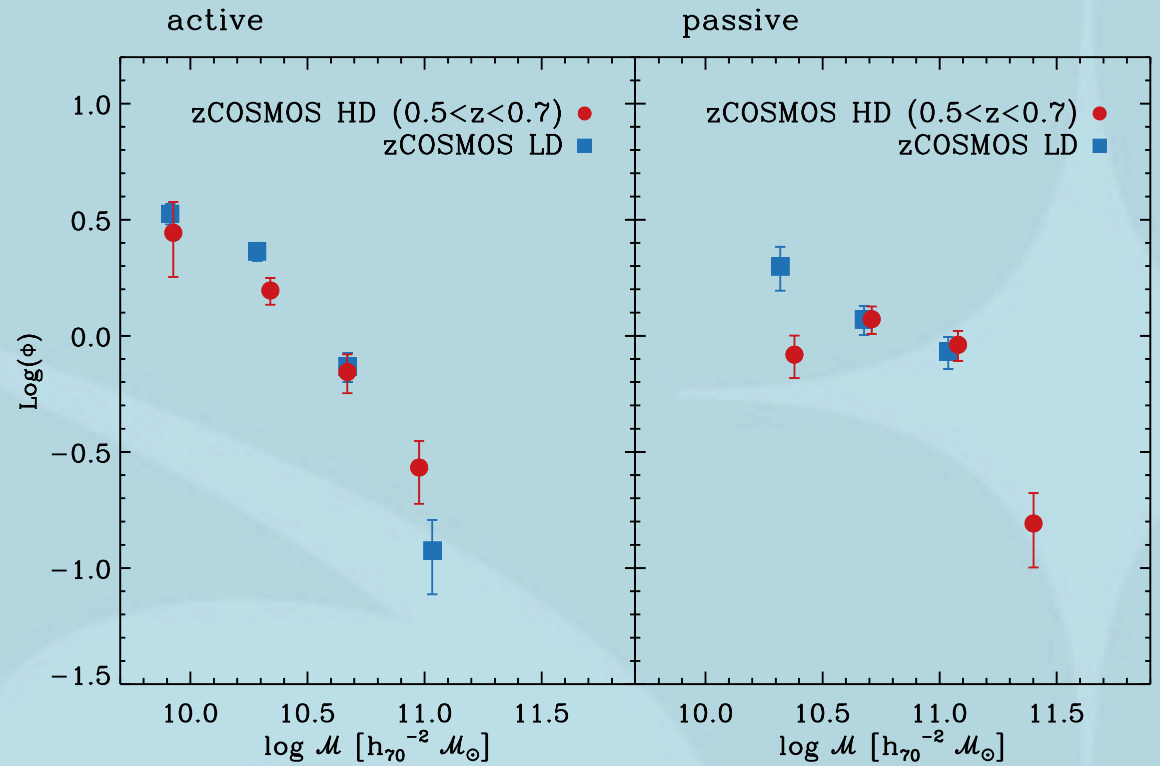
Comparison to zCOSMOS...



Bolzonella+2010

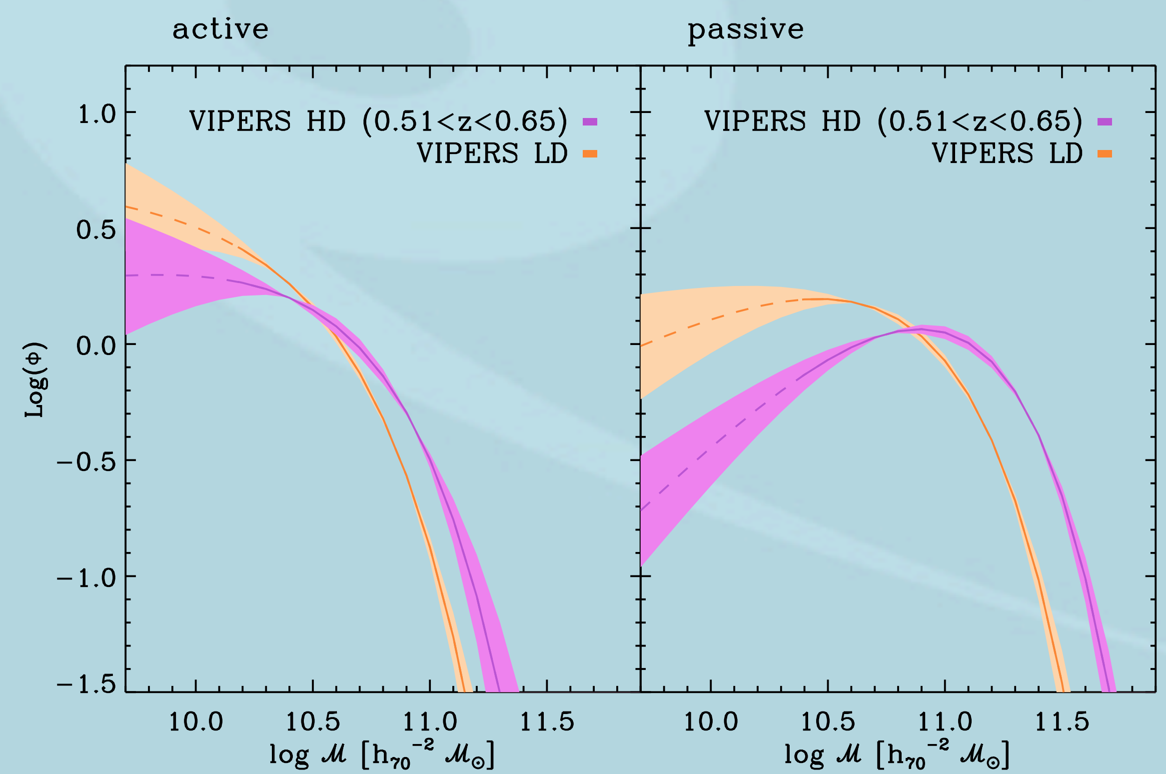
Comparison to zCOSMOS...

zCOSMOS
0.5<z<0.7



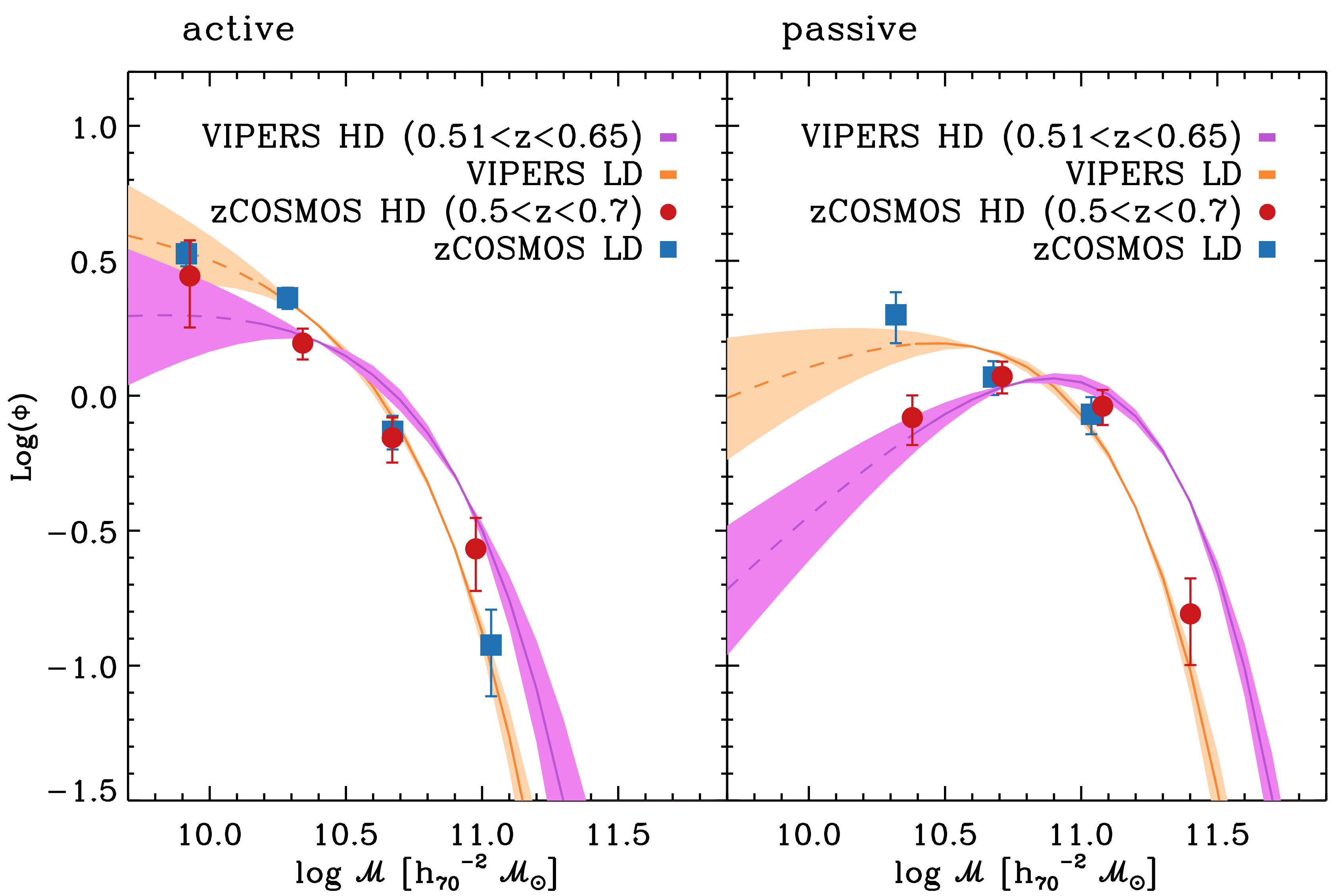
Low density
High density

VIPERS
0.51<z<0.65

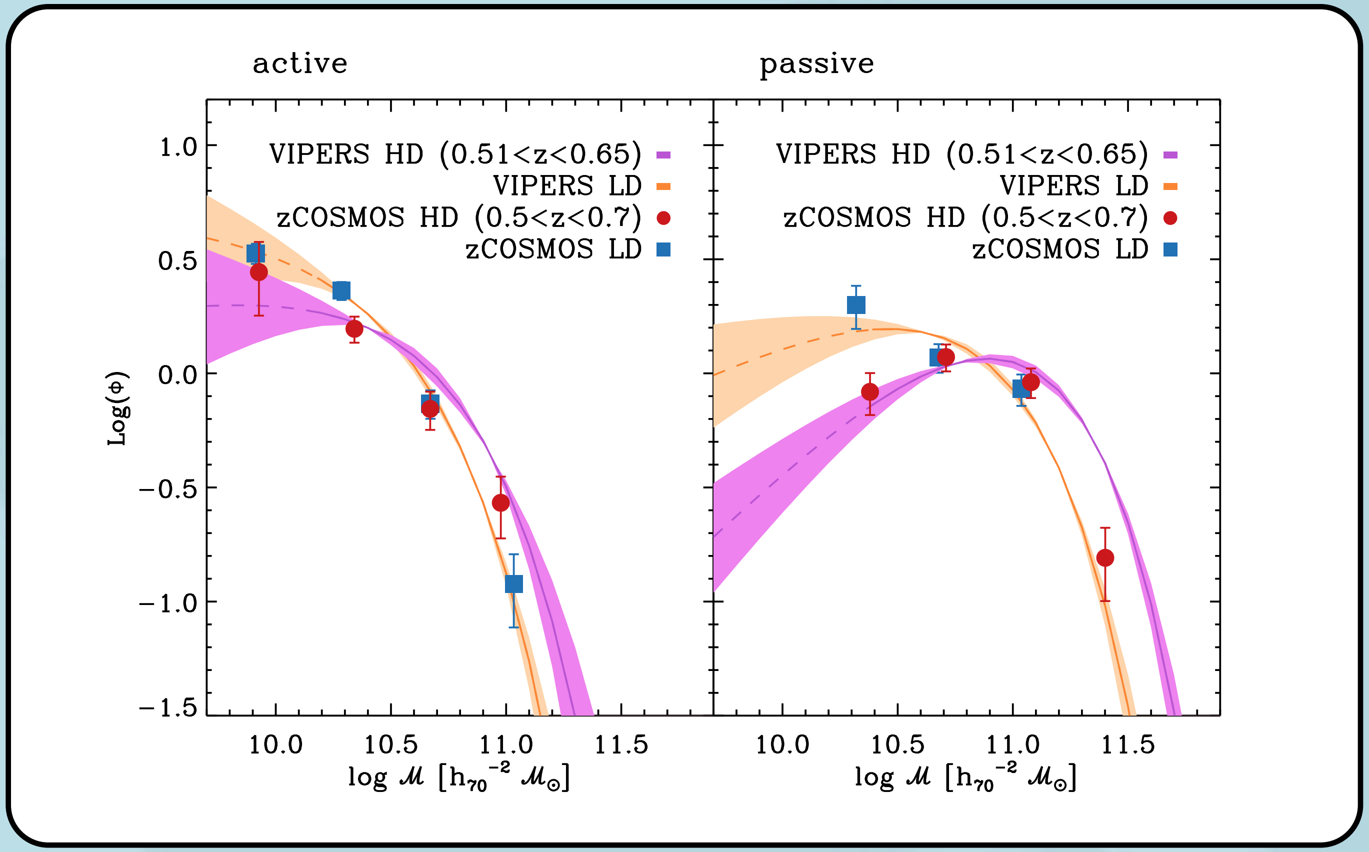


Low density
High density

Comparison to zCOSMOS

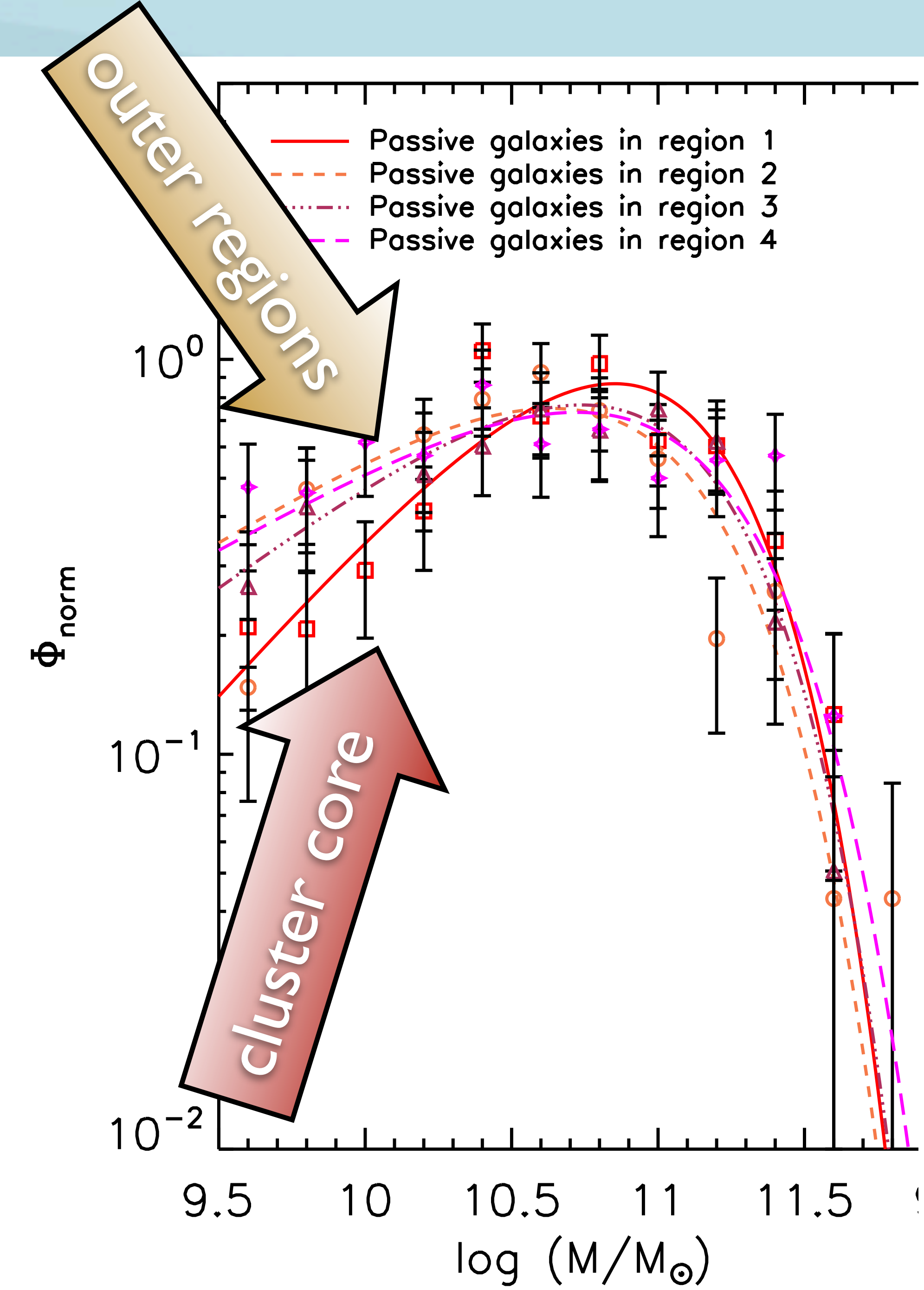


With VIPERS, the exponential tail (i.e., Schechter's $M_\star$) of the passive GSMF is significantly different between HD and LD



VIPERS passive: α_{HD}= 0.0±0.2

α_{LD}=-0.5±0.2



MACS J1206.2-0847
(CLASH-VLT z=0.44)

Annunziatella+14:
passive GSMF steeper
in the highest density
(A&A and poster)

...but see contrasting evidence e.g. in Calvi+12, Vulcani+12
(same GSMF shape in clusters and field)

Discussion

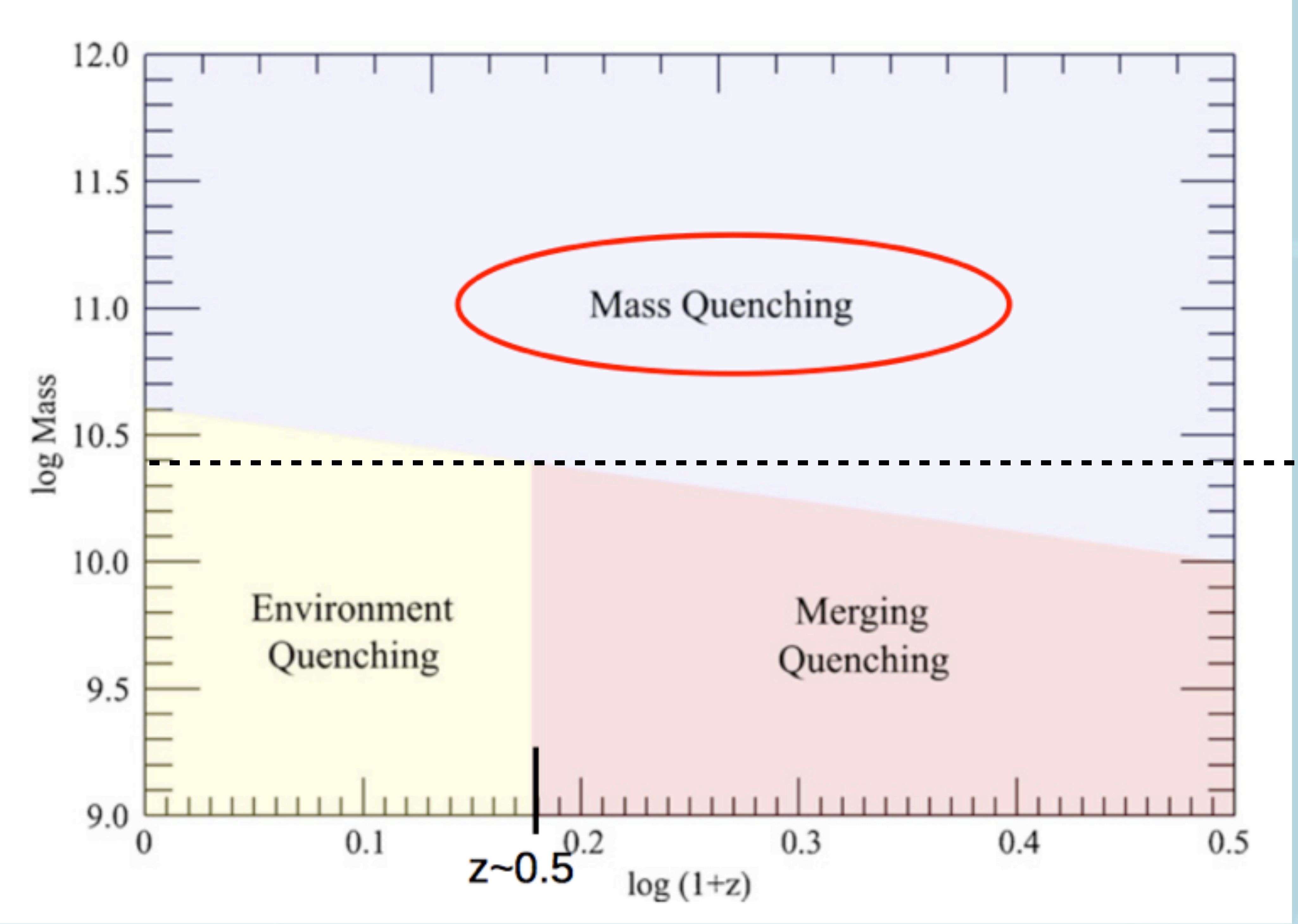
DM perspective:

- Halo mass segregation (more massive ones in the HD regions)
- Environmental history (same halo masses with ≠ merger trees in LD and HD)

Galaxy perspective:

- Differential evolution (= quenching mechanisms, ≠ epoch)
- Environmental quenching

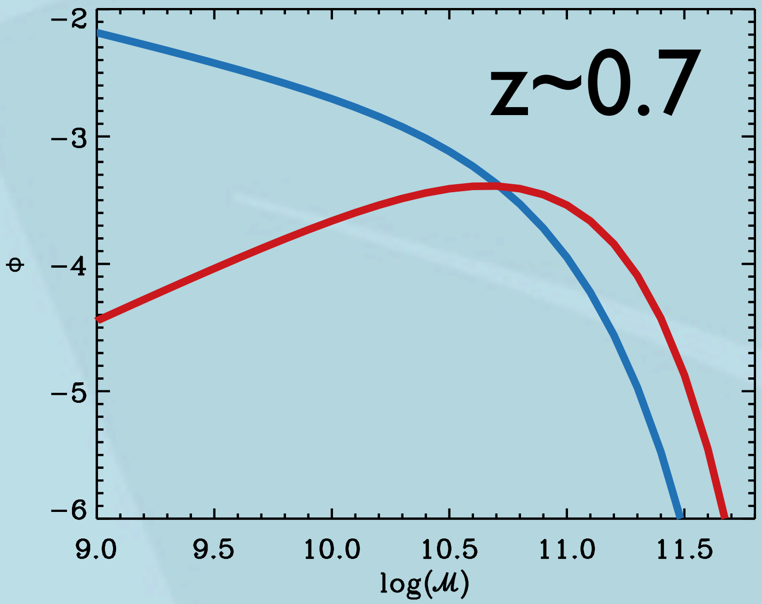
An empirical description (Peng+2010)



Stellar mass limit for VIPERS passive galaxies

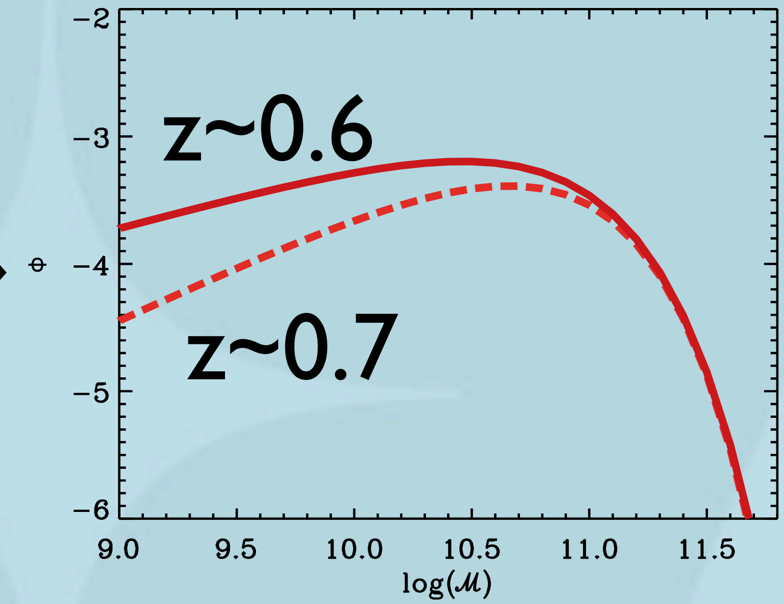
Peng+10

Mass quenching at work



$f_{quench}(\mathcal{M},z)$

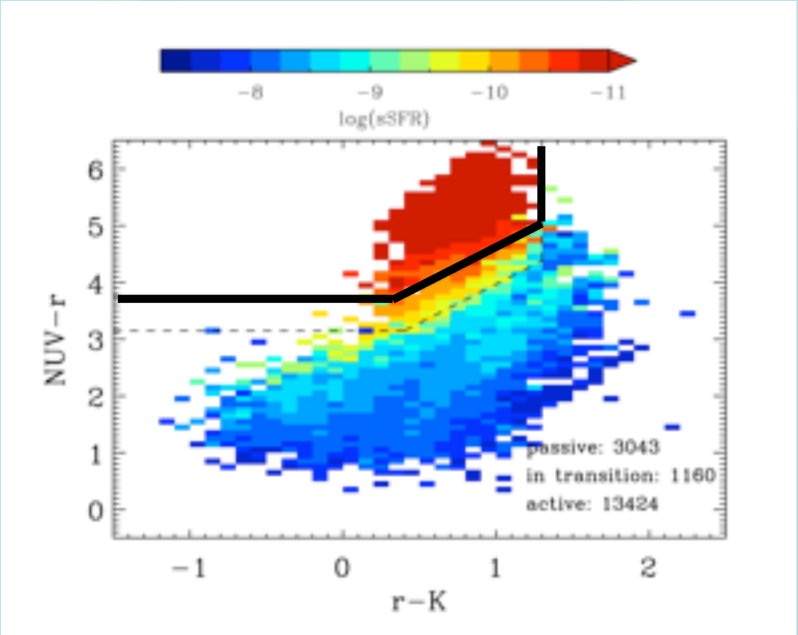
$\propto$ SFR $(\mathcal{M},z)$ / $\mathcal{M}_{\star}$



(see a similar approach in van der Burg+2013)

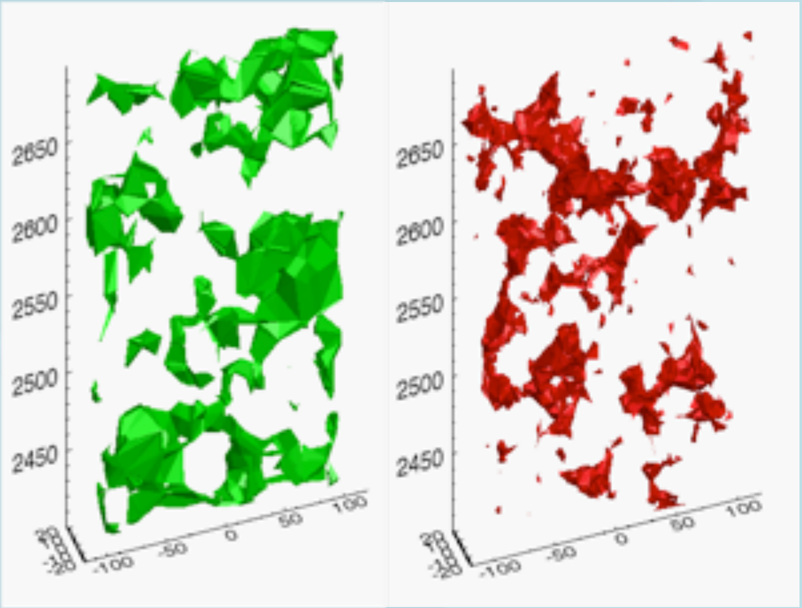
<u>Galaxy types</u>

passive vs. active

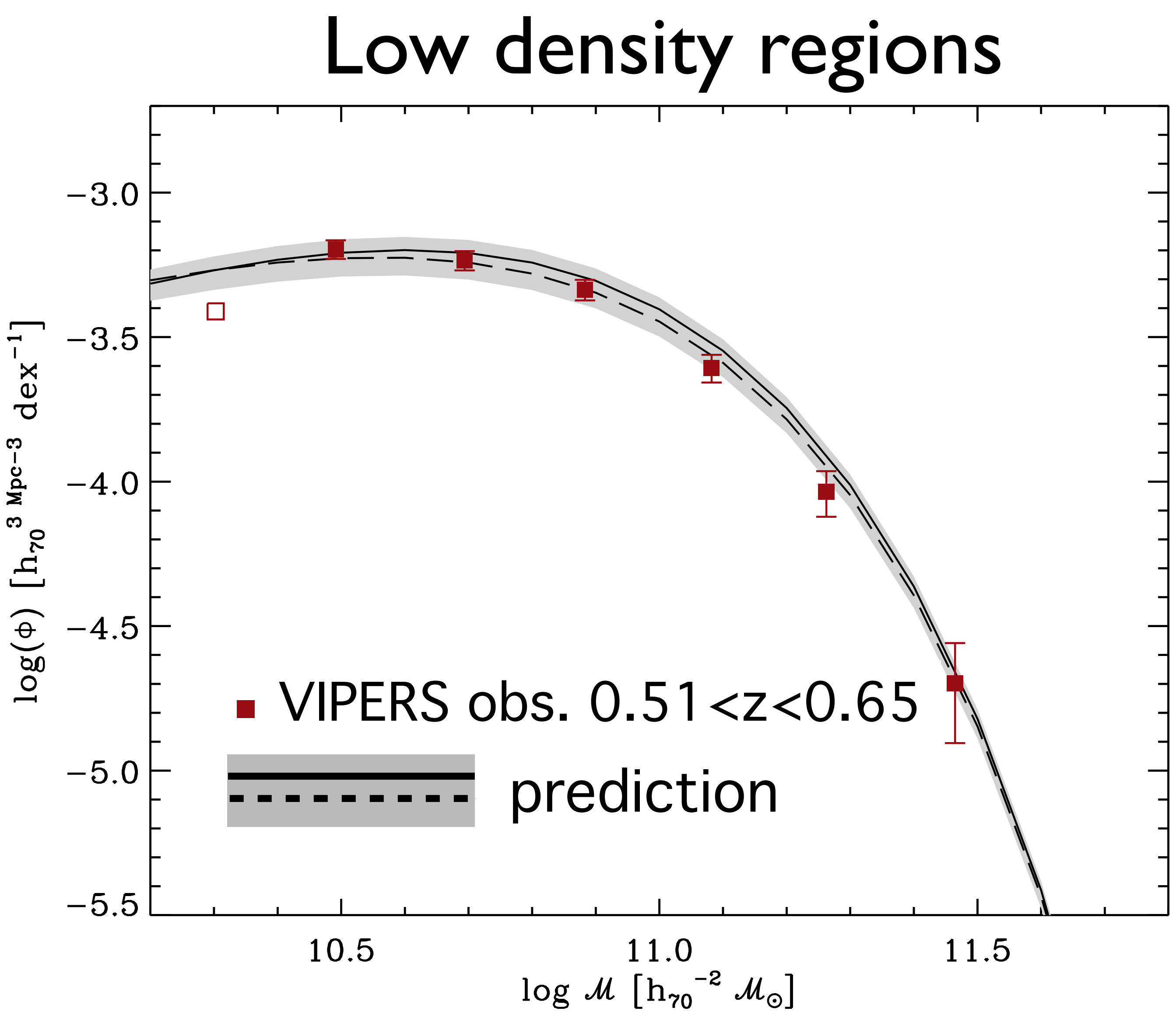


<u>GSMF normalisation</u>

by Voronoi's volumes

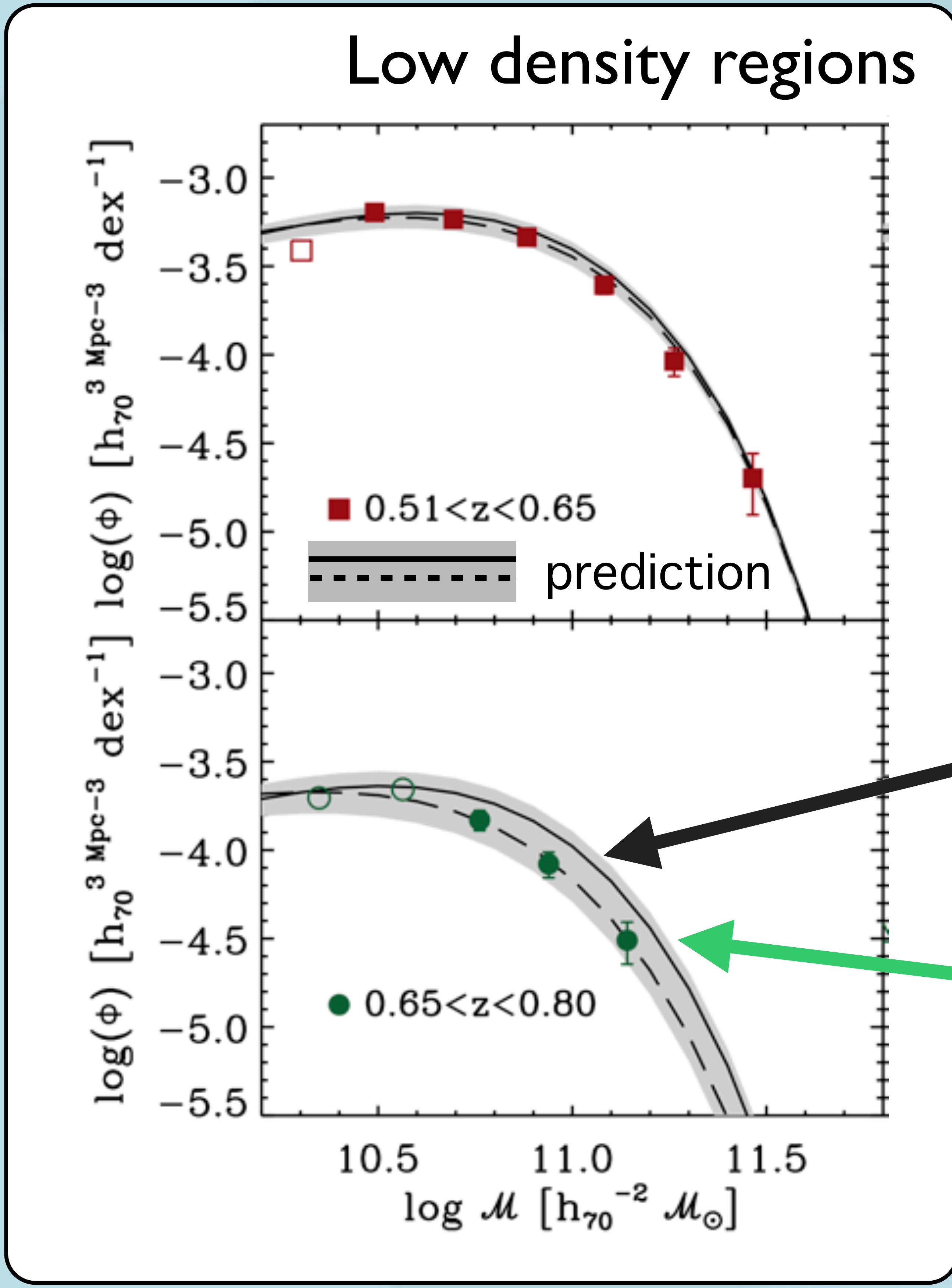


Applying Peng+10 formalism to VIPERS data

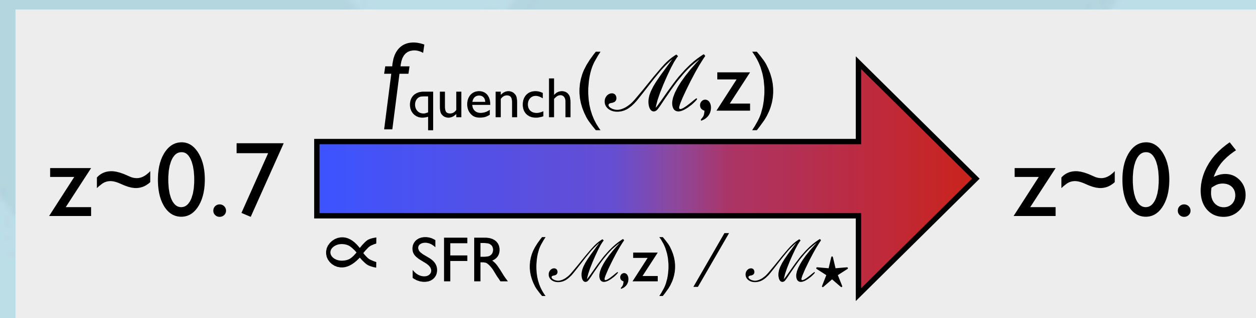


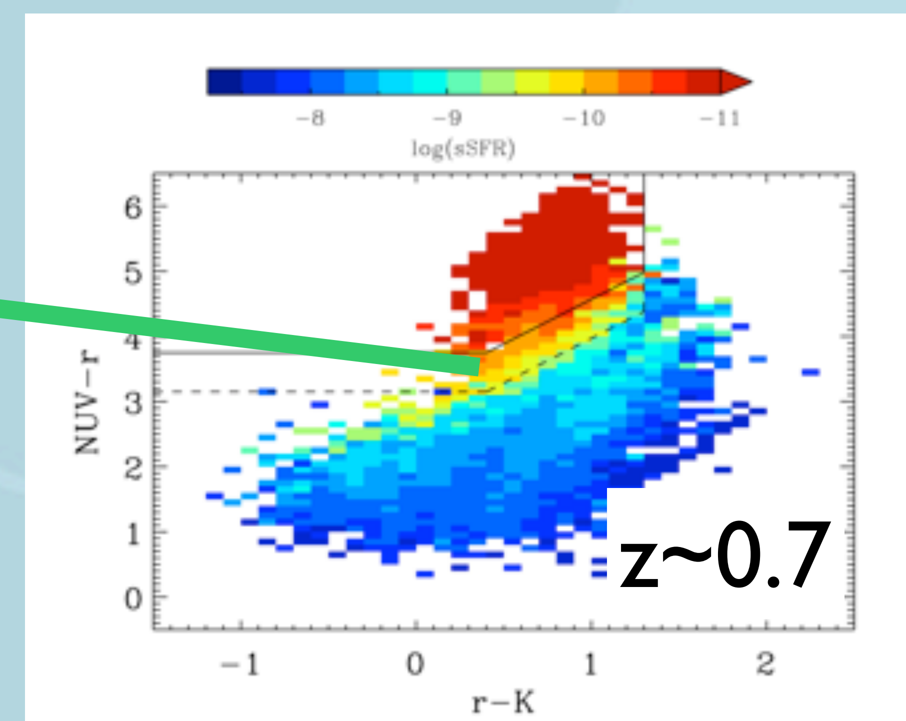
Starting from the observed GSMF at 0.65<z<0.8, we get a prediction at 0.5<z<0.65

We compare it to VIPERS data at the same redshift

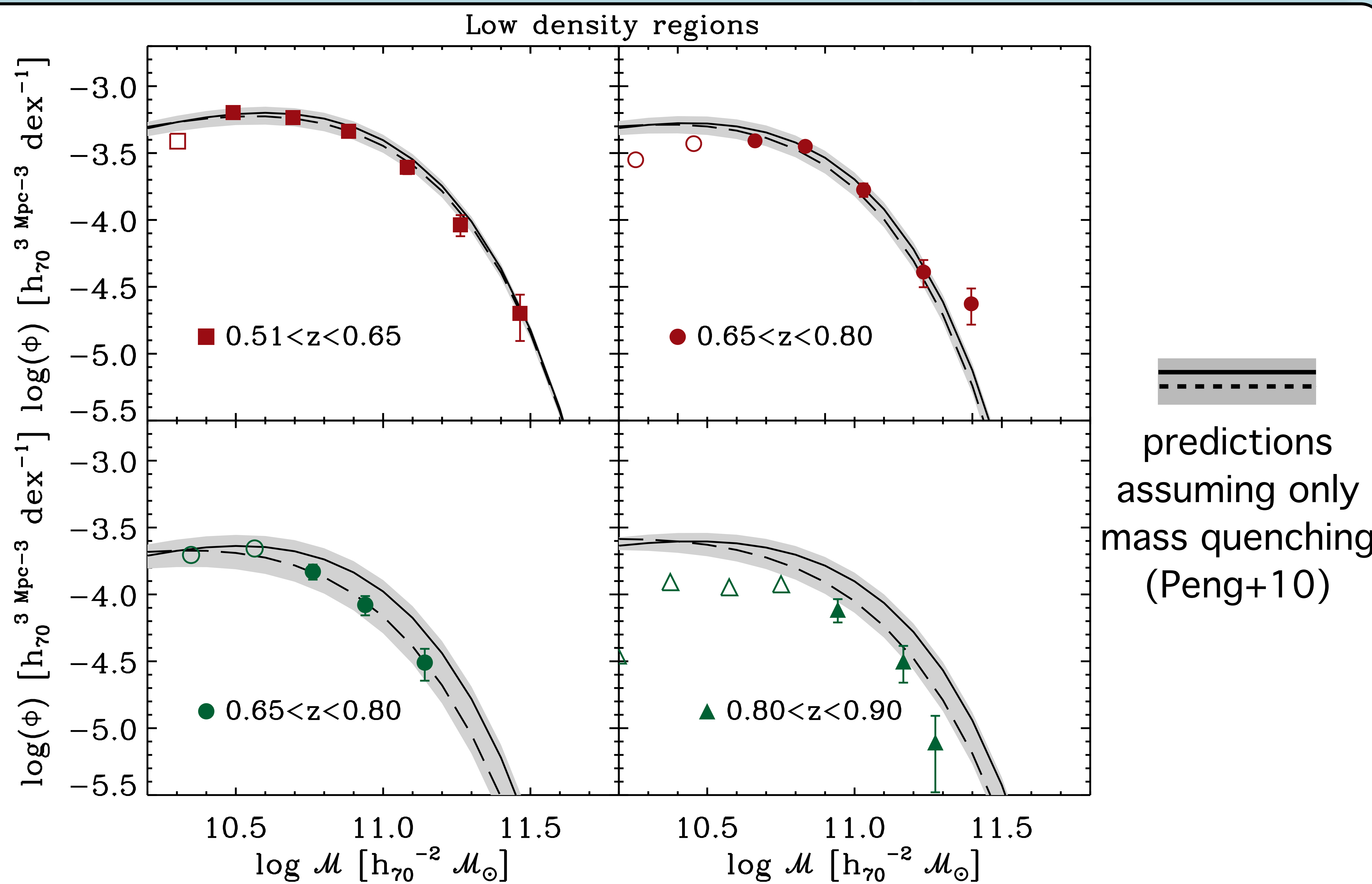


NUV-r-K suggests that in ~0.8 Gyr only green galaxies could have time to become passive

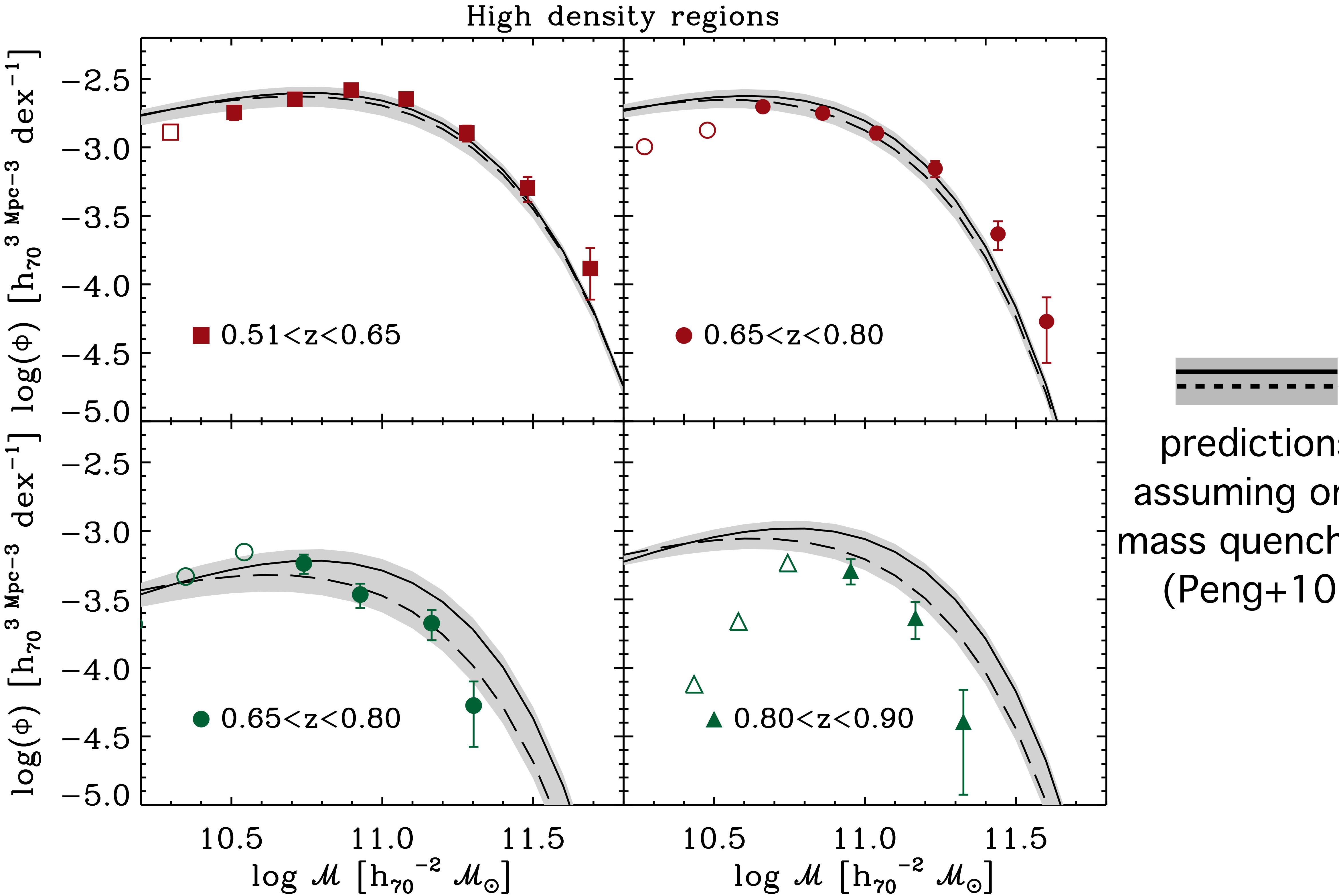




Low density regions

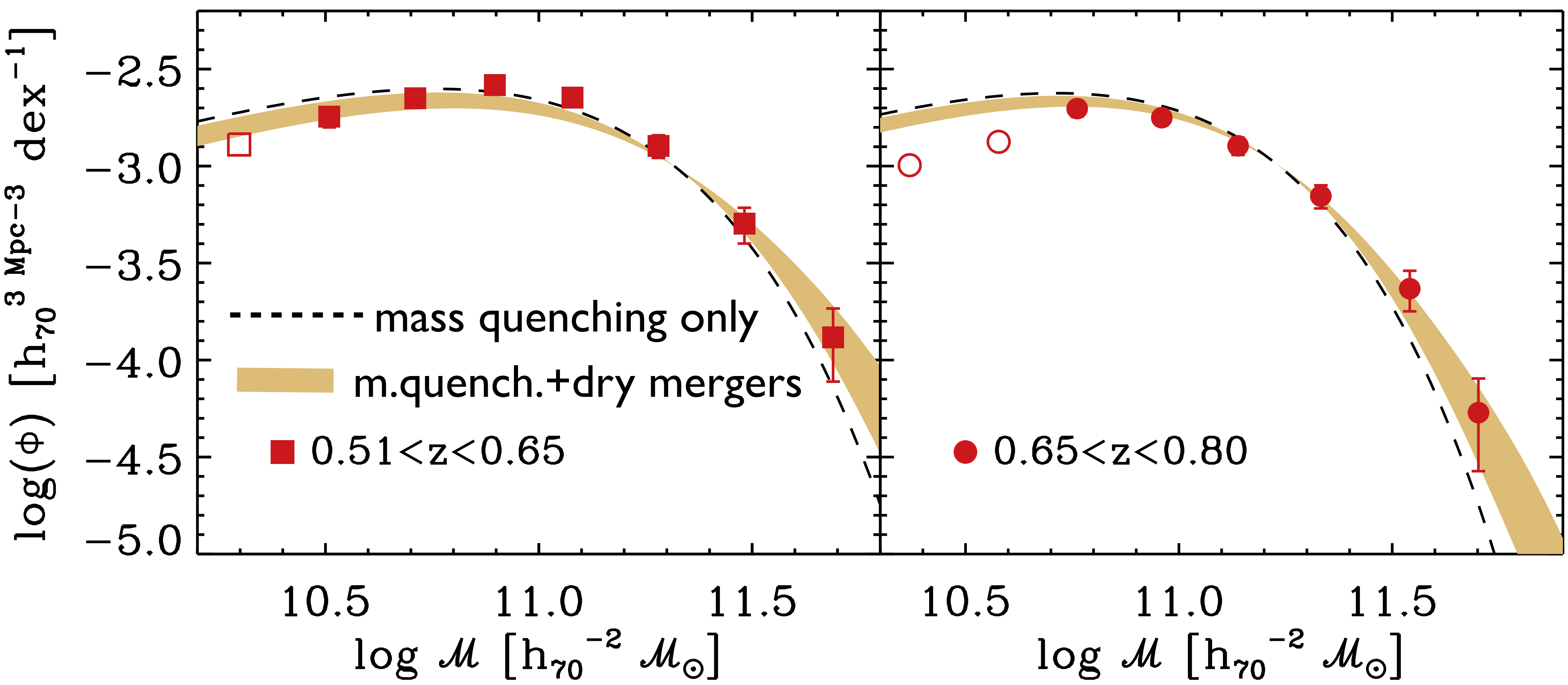


High density regions



predictions assuming only mass quenching (Peng+10)

Post-quenching effects in the HD regions



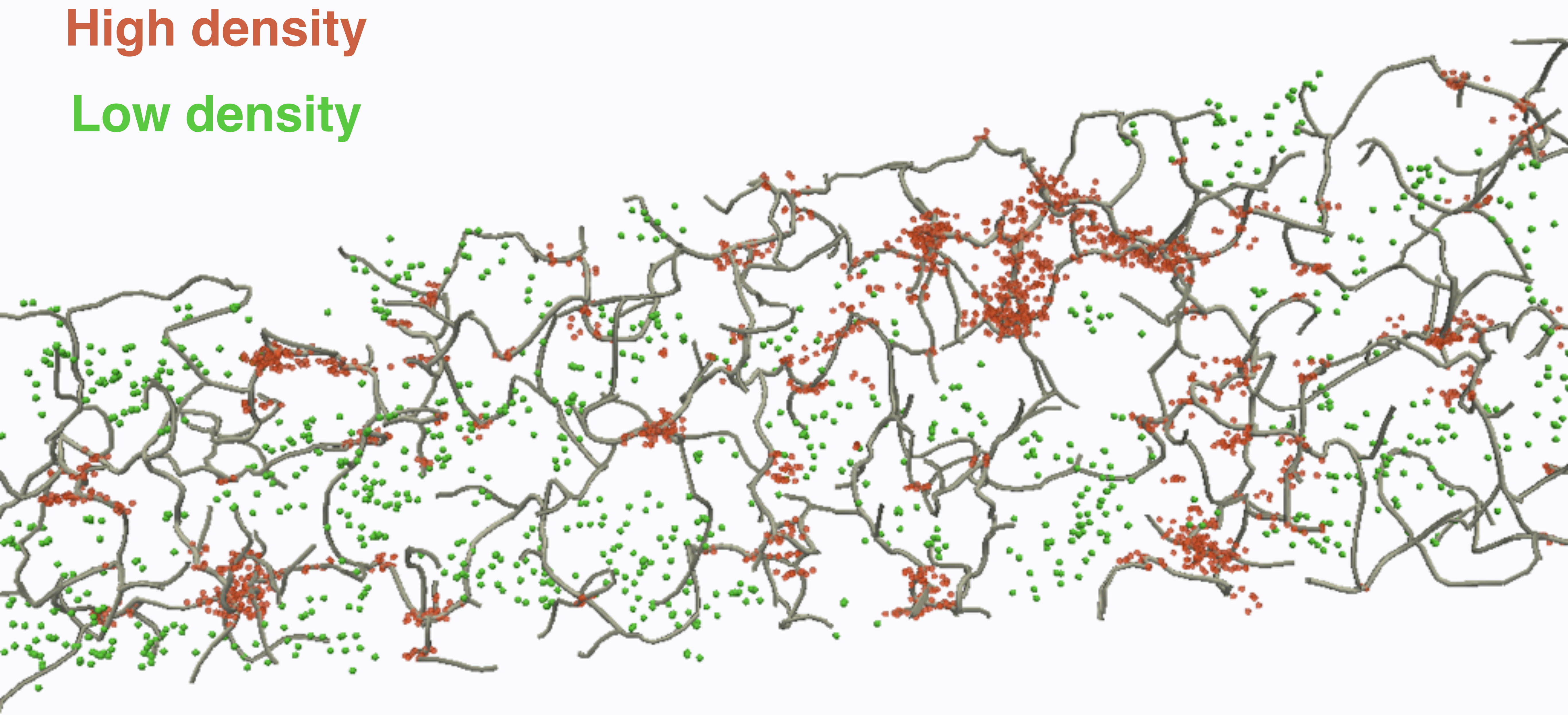
- Dry merging modifies the shape of the passive GSMF
- Better agreement with VIPERS when including 20-30% galaxy mergers (1:1 mass ratio)

Summarising

- VIPERS offers unprecedented statistical power to study galaxy evolution.
- Accurate z_{spec} allow us to identify 3-D environments.
- The environment modifies the GSMF shape, especially in the high-mass end.
- Environment dependence of the GSMF, as described by Peng et al., is supported by our data (first piece of evidence at $z>0$).

A one-minute vacation in the VIPERS environment

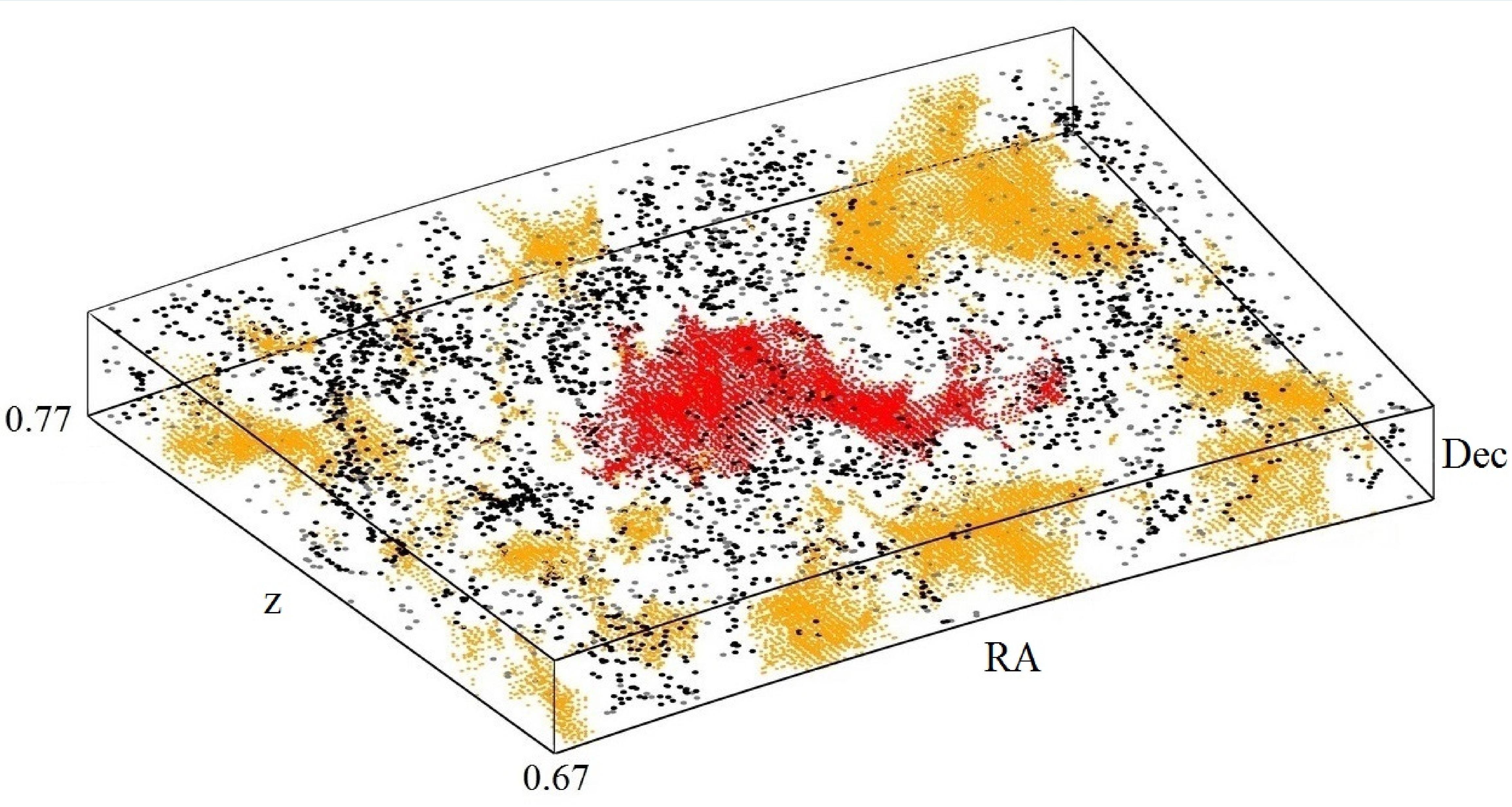
Filaments



ID et al., in prep

Disperse algorithm (Sousbie 2011)

Voids

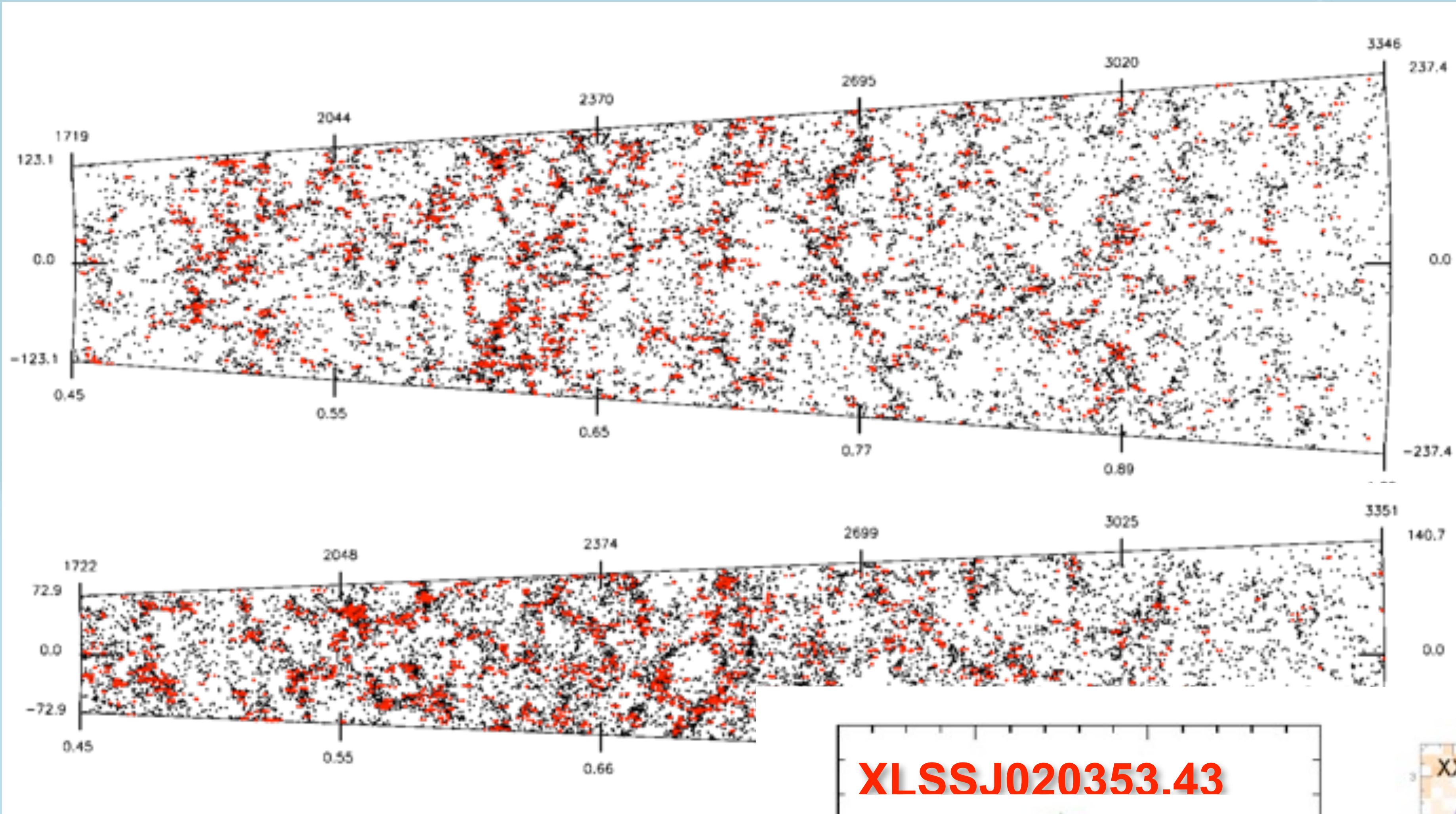


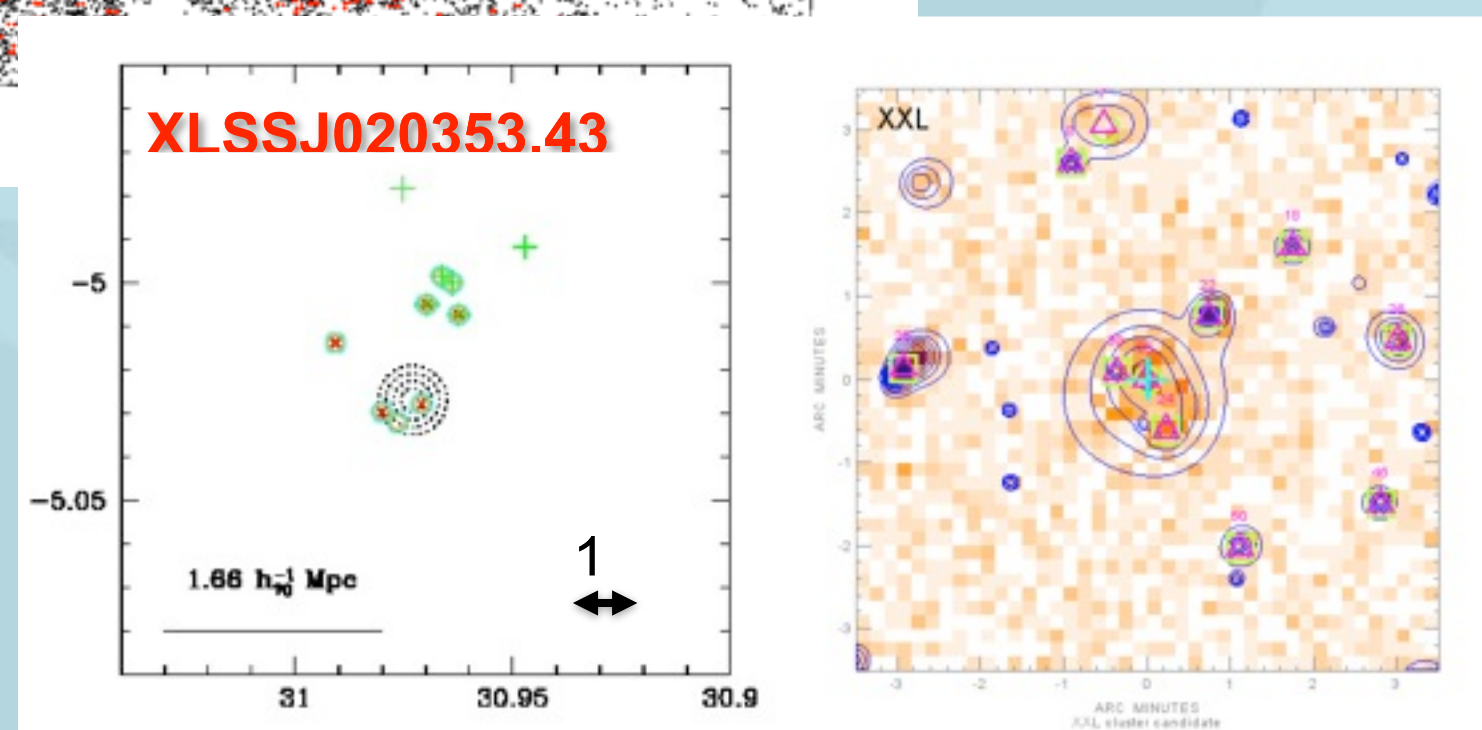
Micheletti+2014

Groups

W1

W4





Iovino et al., in prep.

Thank you!

Any question?