"A WALL in the Universe"

Exploring the onset of environment-driven trends at z~0.73

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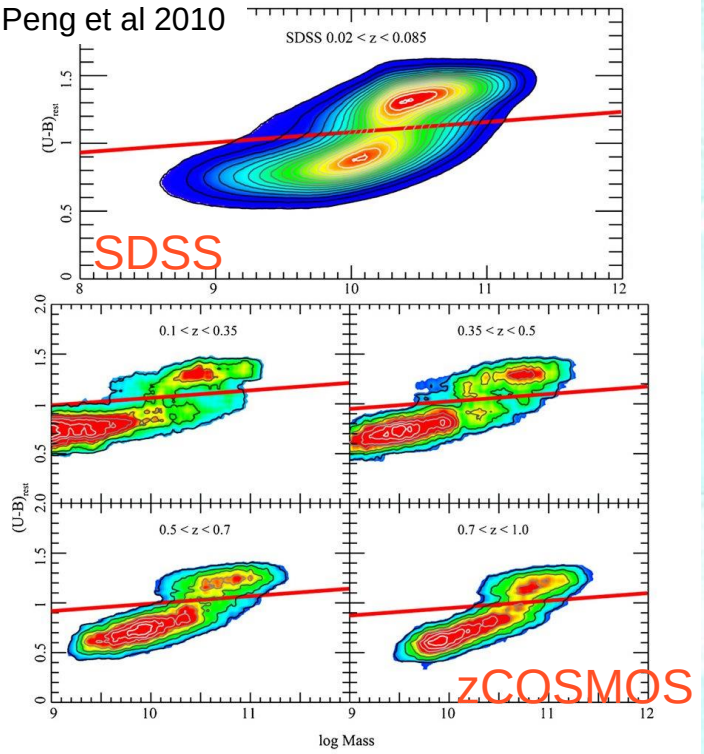
Outline

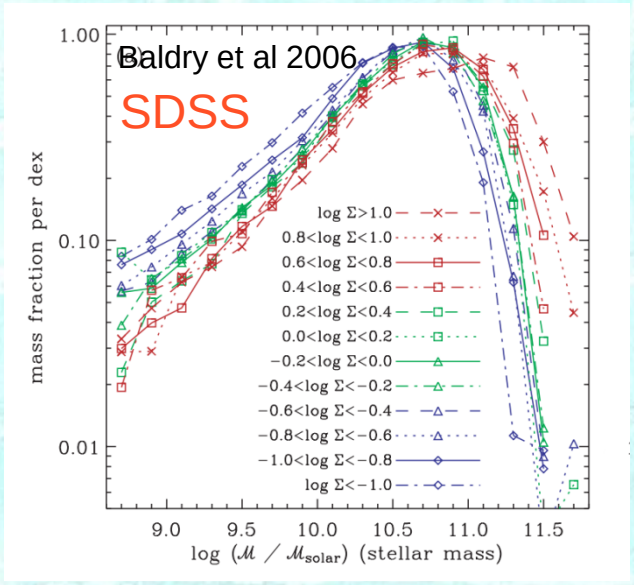
- Introduction
- The new spectroscopic sample
- The COSMOS WALL in *HD*
- Galaxy properties (color-SFR): f(mass), f(environment)
- Tackle open questions on relevant mechanisms and scales

Galaxy properties depend on mass & mass depends on the environment

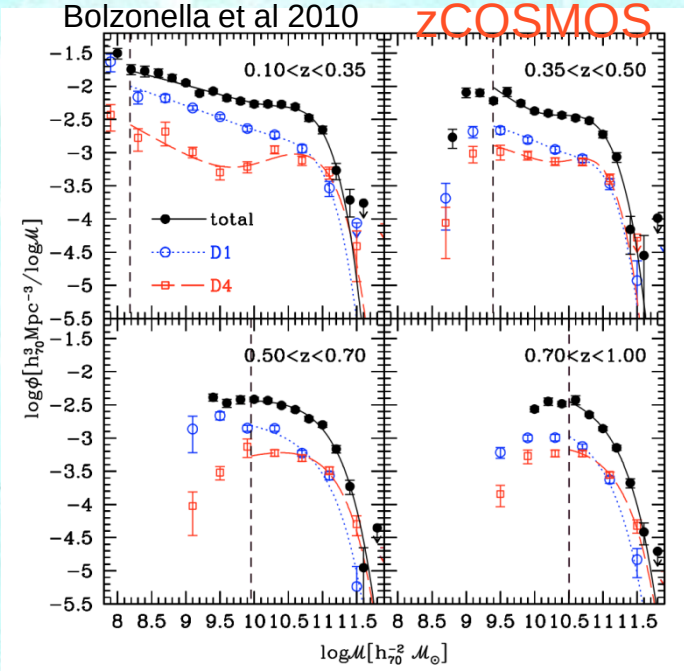
Peng et al 2010



Baldry et al 2006



Bolzonella et al 2010



Galaxy stellar mass distribution depends on the environment

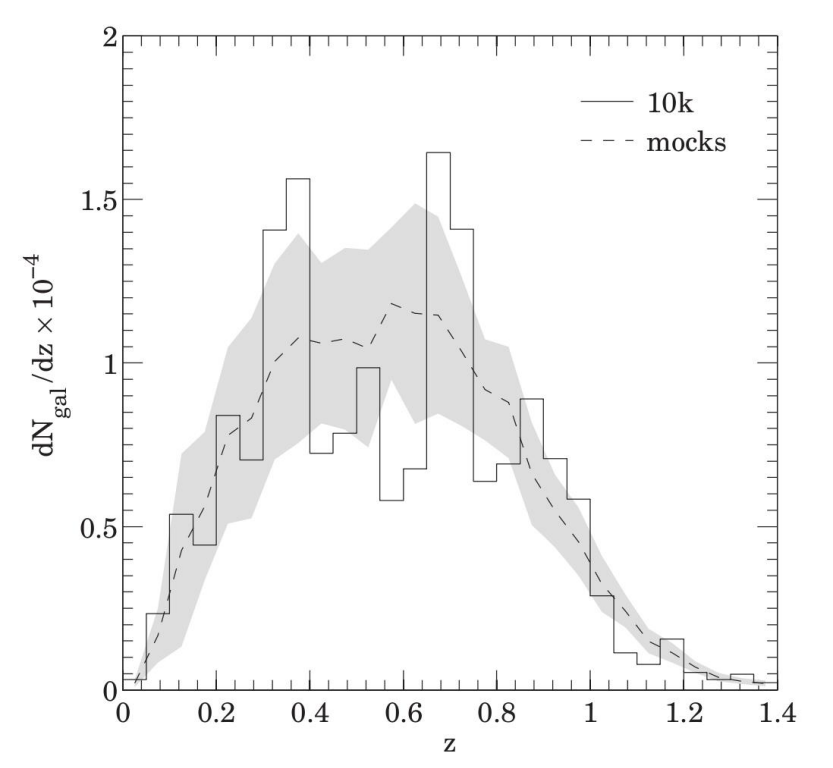
Galaxy properties (e.g. color, SFR etc) depend on stellar mass.

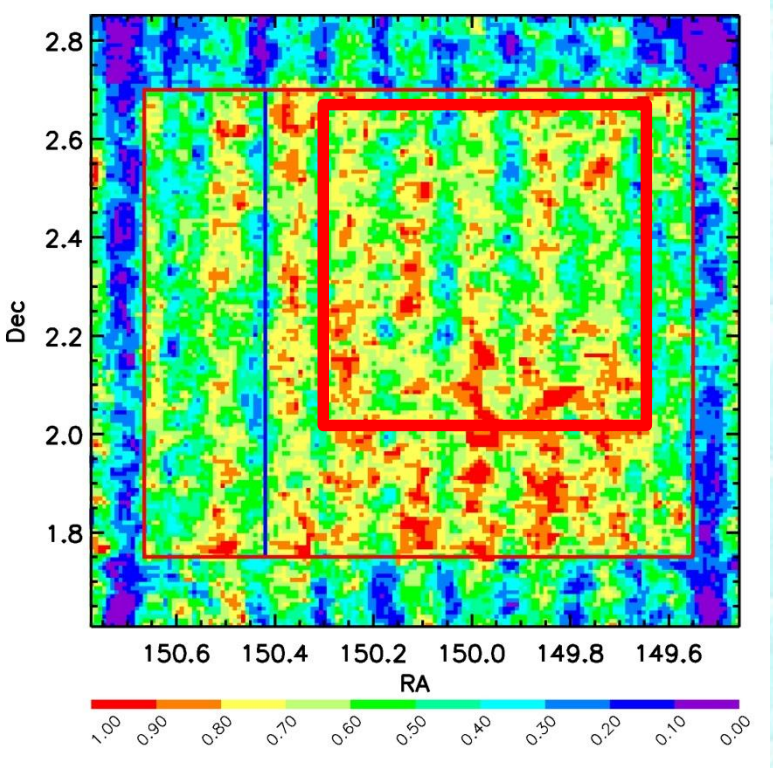
To study galaxy properties vs Environment:

we need to take into account the mass-environment correlation

- Work in narrow mass bins
- Use large **mass-complete** samples that cover a wide mass range

The COSMOS WALL @ z=0.73



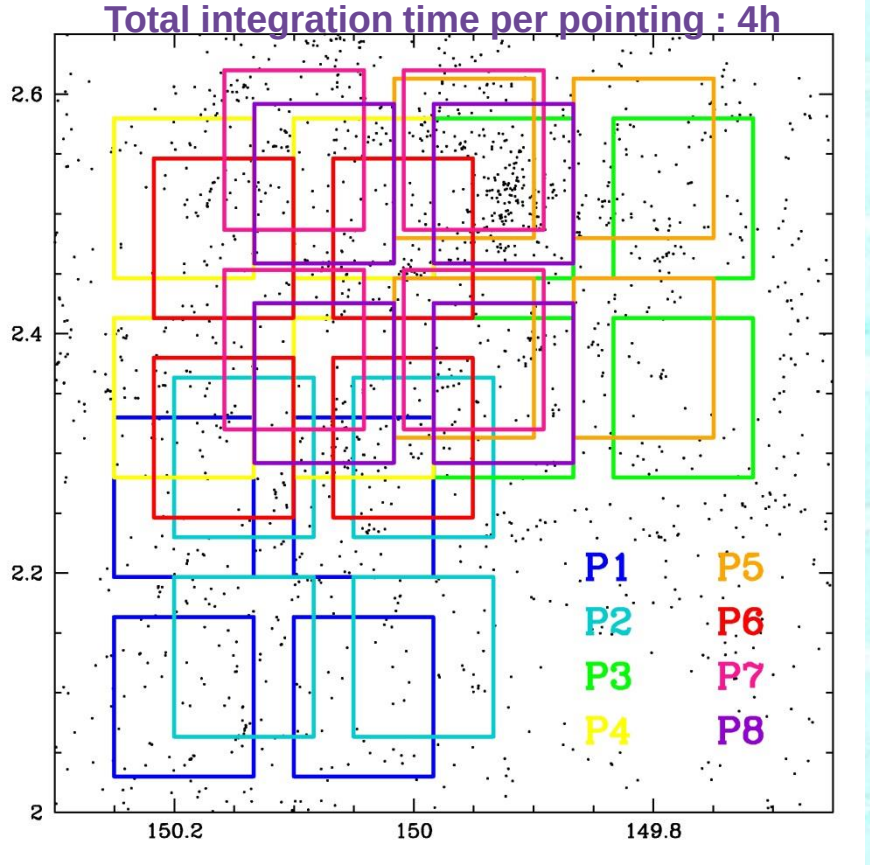


20K zCOSMOS TSR

VIMOS Observations

40 h of VIMOS-VLT (R~600MR grism) **P.I Iovino**

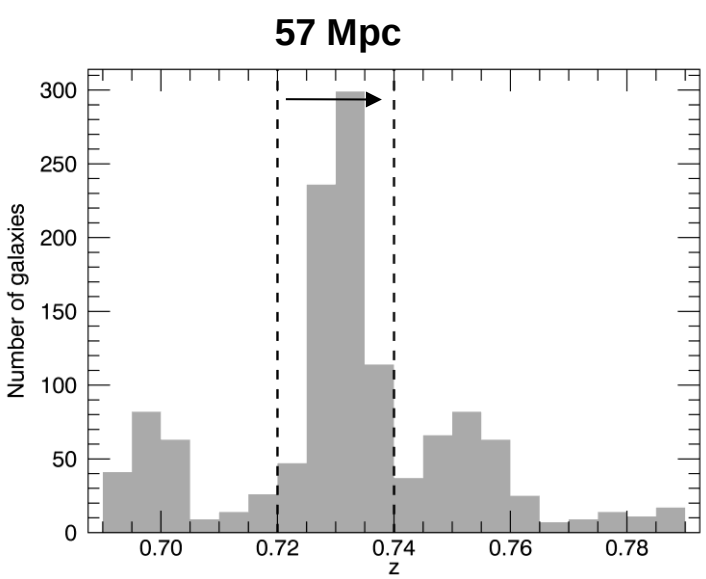
- Increase zCOSMOS spectroscopic sample
- Observe a mass-selected sample & push down mass completeness from 10.7 to 9.7

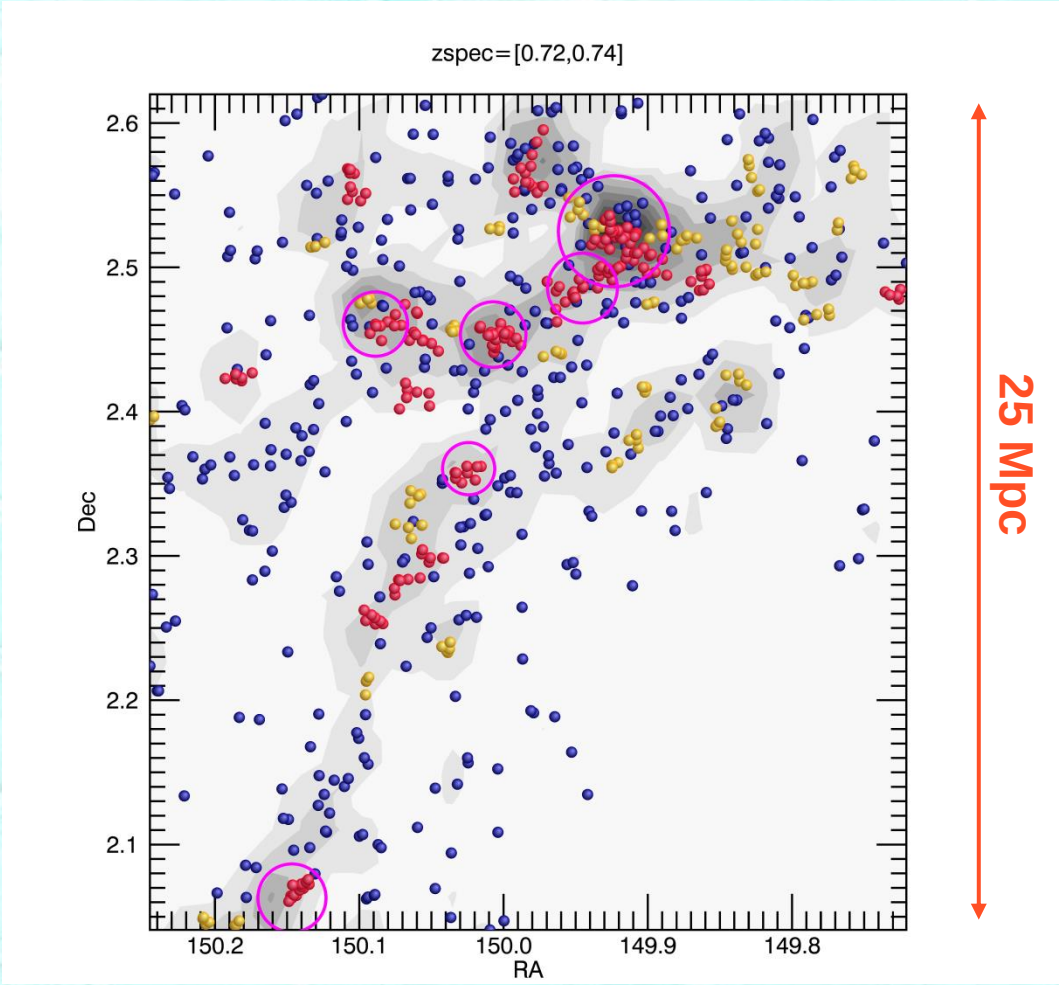


The total Wall sample
(VIMOS new obs. + zCOSMOS data)

The WALL numbers		z=[0.69-0.79]
New VIMOS obs	Brand new	623
	Reobserved zCOSMOS	233
zCOSMOS only		406
Total WALL sample		1262

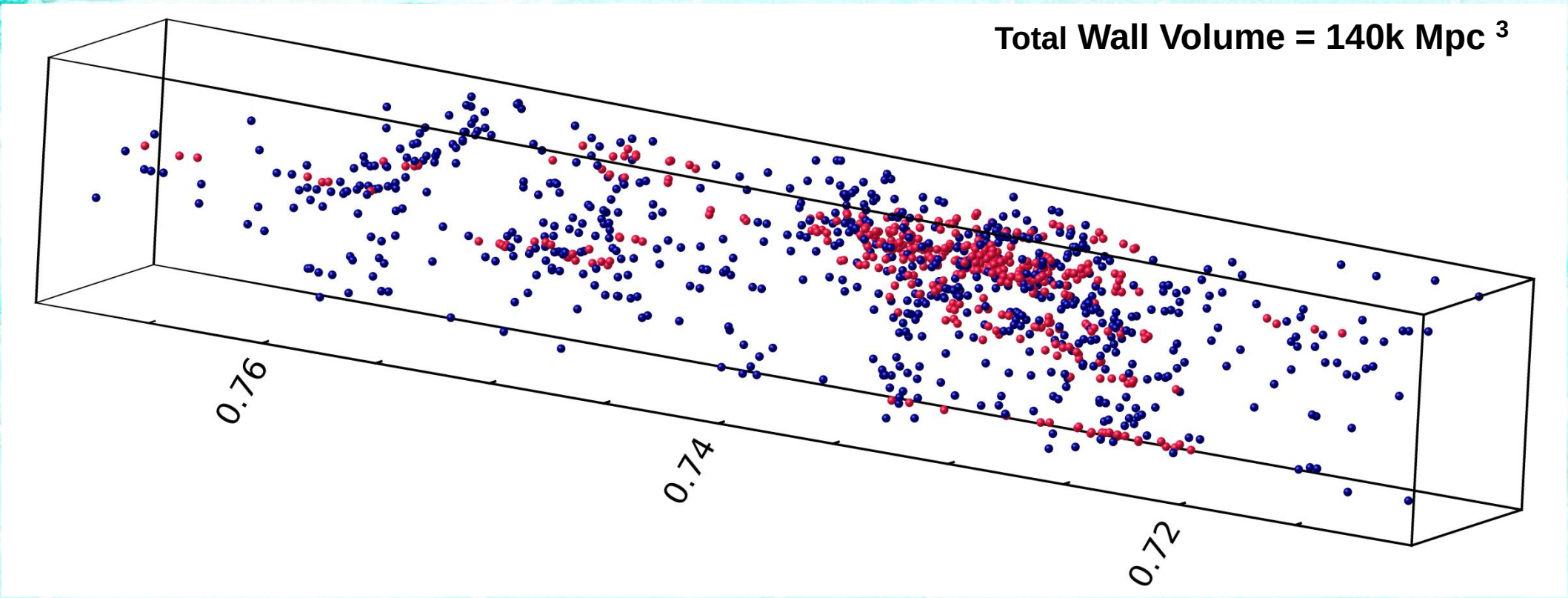
Note: Considering objects with flagz >=1.5(+9.5)
(flagz as in zCOSMOS)



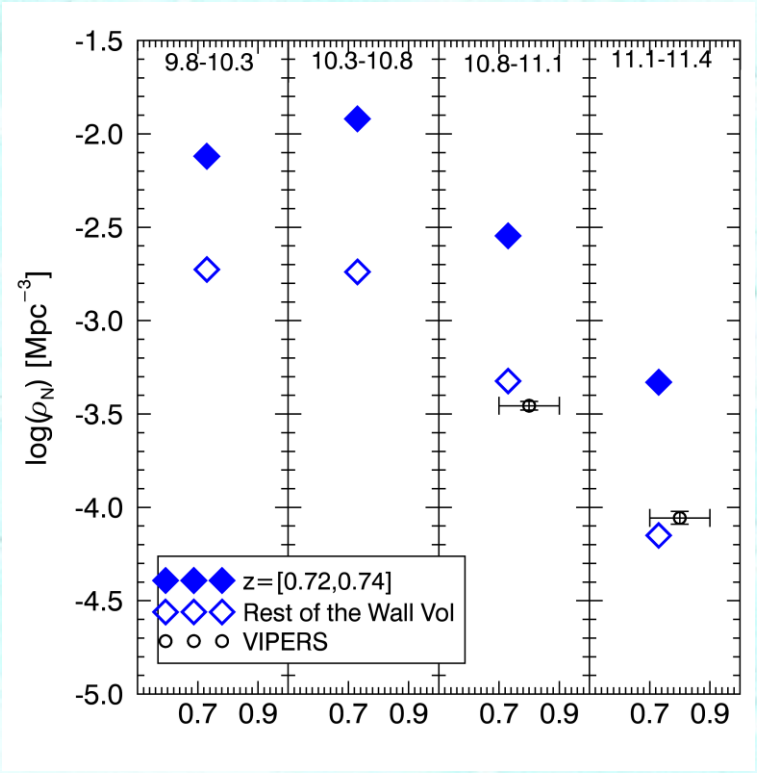


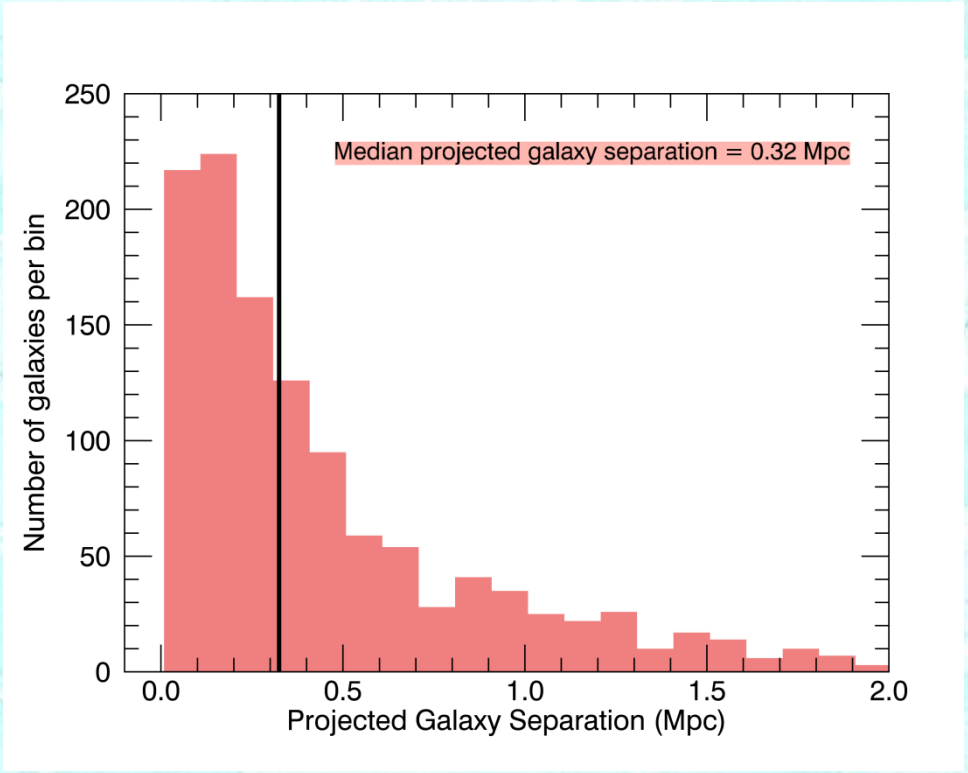
Surface density map of the WALL. In red and yellow are galaxies in groups.
Magenta circles indicate X-ray extended sources.

The total Wall sample



Galaxy density in the LSS

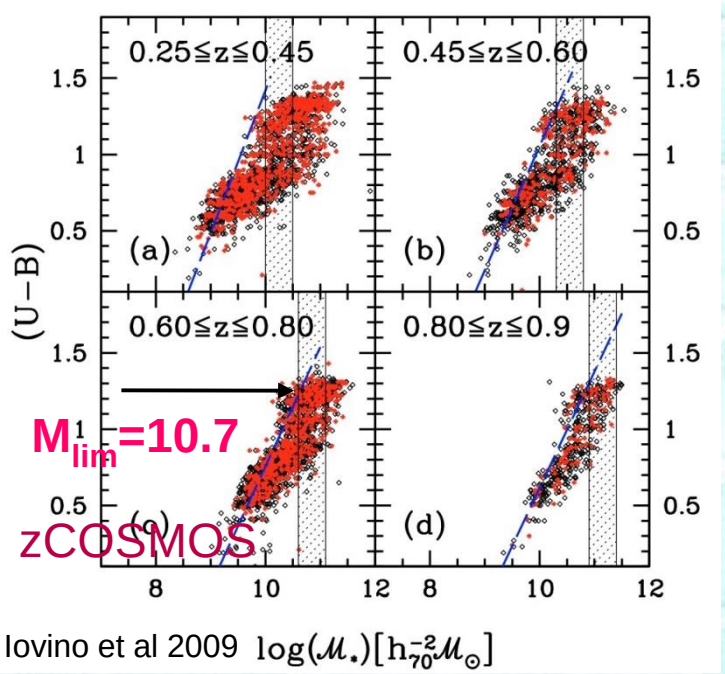




Galaxy number density in mass bins:
- Out of the LSS =VIPERS (Davidzon et al 2013)
- In the LSS higher

We zoomed in a dense galaxy field!

Mass Completeness

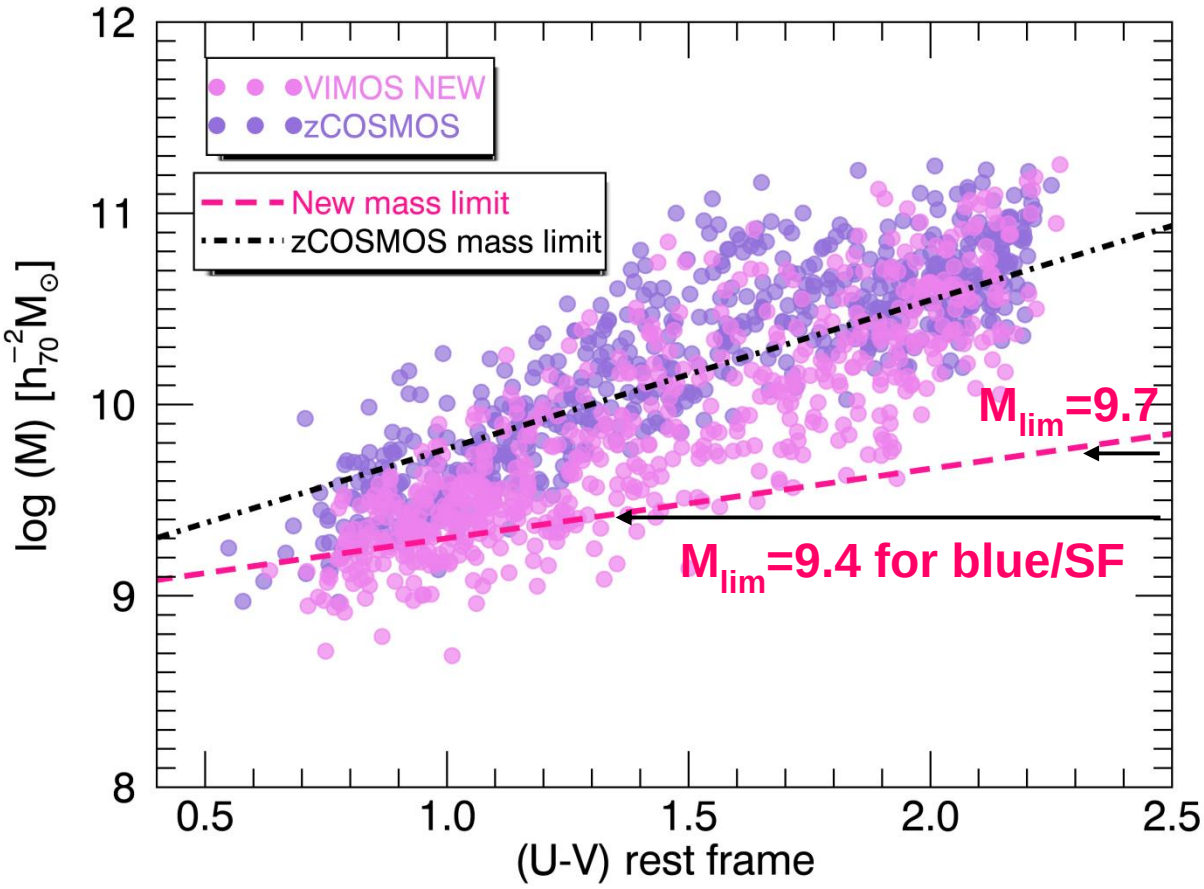


Iovino et al 2009 $\log(\mathcal{M}_*)[h_{70}^{-2}\mathcal{M}_\odot]$

Blue line: Color dependent
85% completeness mass-limit

Our new data provide the missing red counterparts of the existing zCOSMOS data for the low mass blue galaxies.

We extend by almost one decade in mass the mass-complete sample available for our analysis.



Masses and rest frame colors have been derived using the *Hyperzmass* code (Bolzonella et al. 2009)

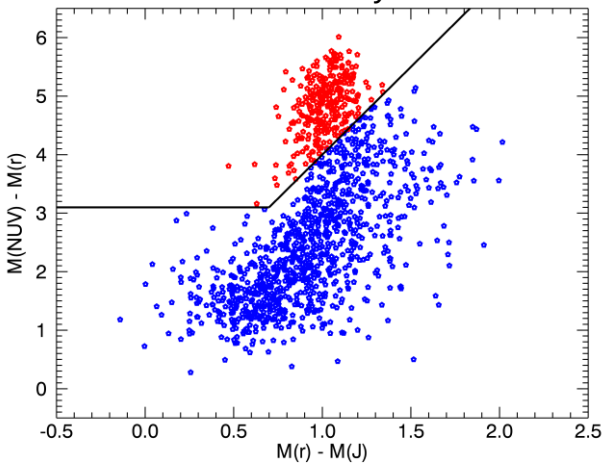
The Wall sample

- A statistically significant **spectroscopic** sample of **1262** galaxies
- **Mass-complete** sample to an order of magnitude lower mass-limit than zCOSMOS
- Narrow redshift slice at a **lookback time 6.5 Gyr**: no time evolution
- Variety of **environments**: a cluster, several groups, filaments, less dense regions
- COSMOS and zCOSMOS auxiliary data
  - **HST/ACS imaging**
  - **multi-band optical/infrared photometry**
  - **X-ray data**

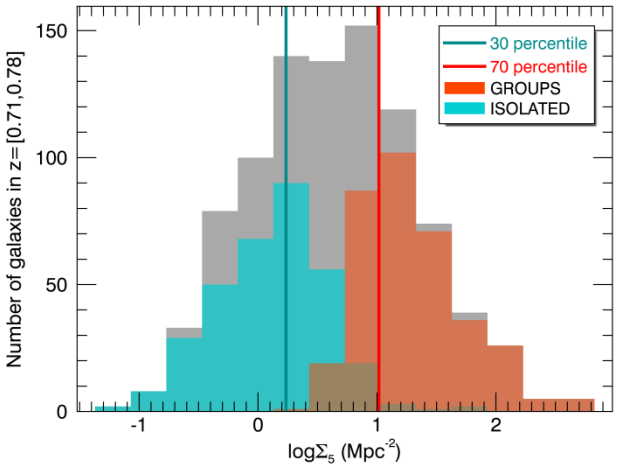
Fraction of galaxies

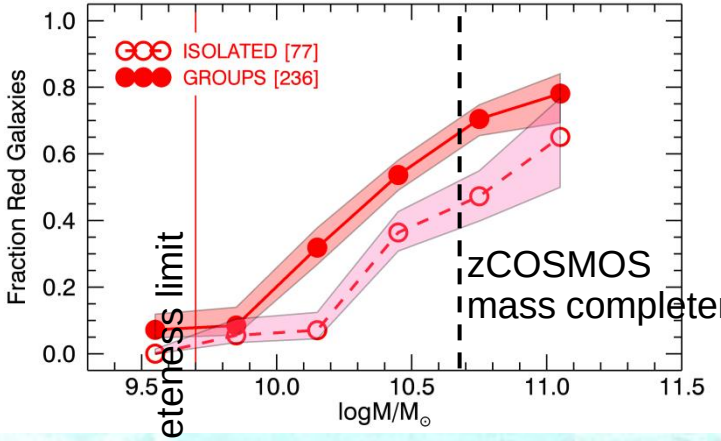
f(color) f(mass) f(environment)

Color-color classification by Ilbert et al 2013



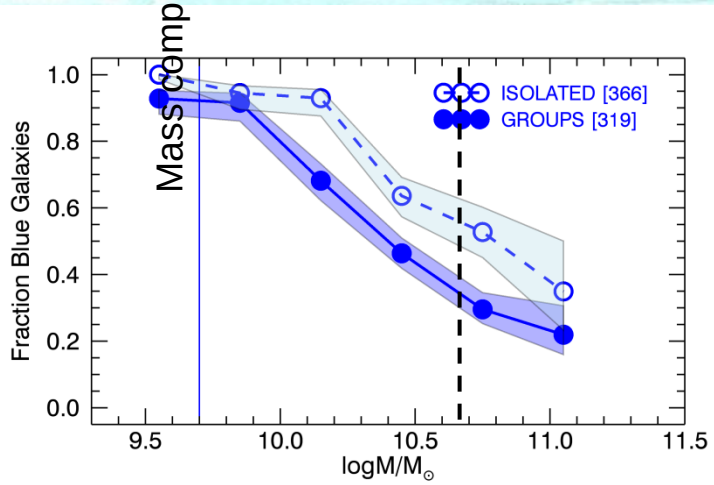
Groups = Weighted numerosity > 5
Isolated = Weighted numerosity < 2





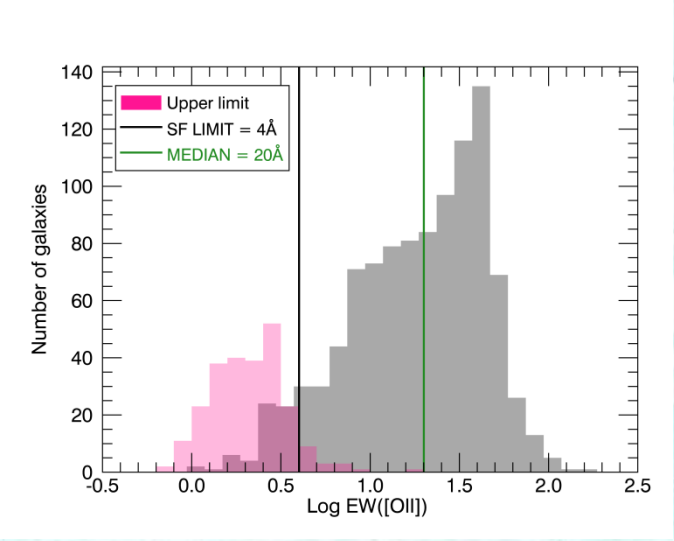
zCOSMOS
mass completeness limit

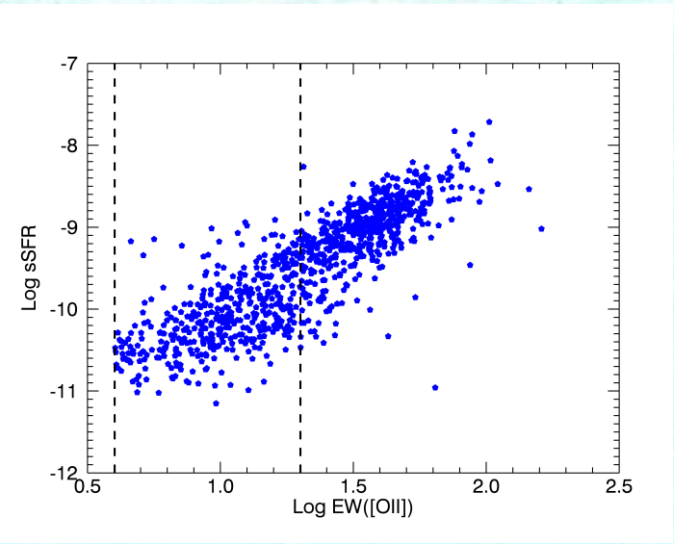
Mass completeness limit

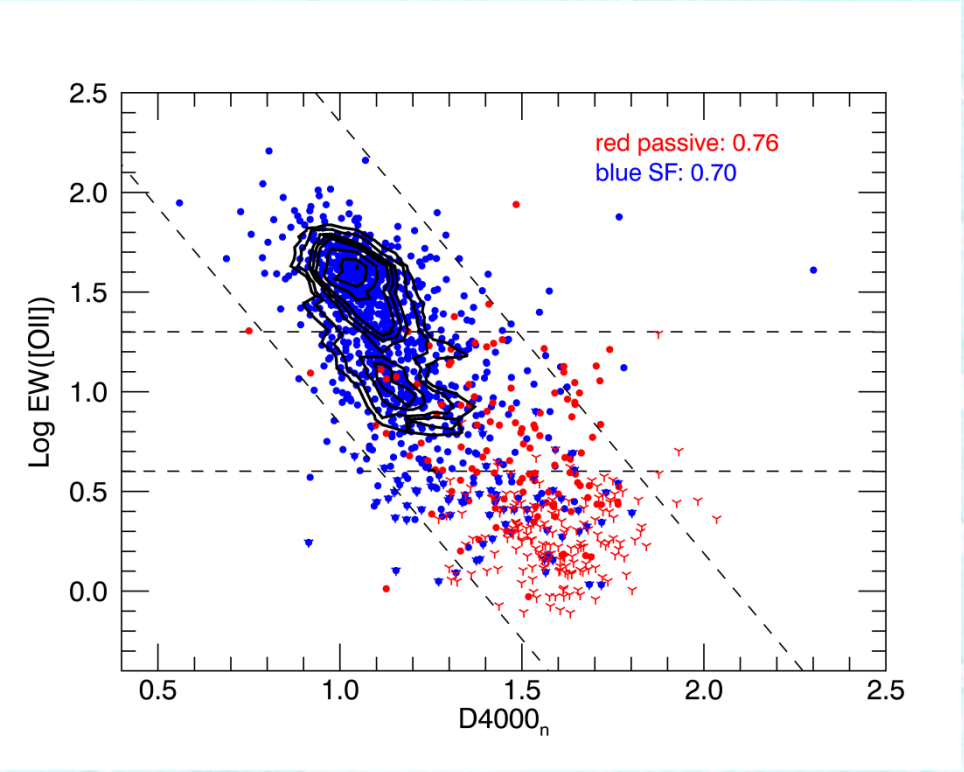


See also Iovino et al 2010 for zCOSMOS

Intermediate galaxy population



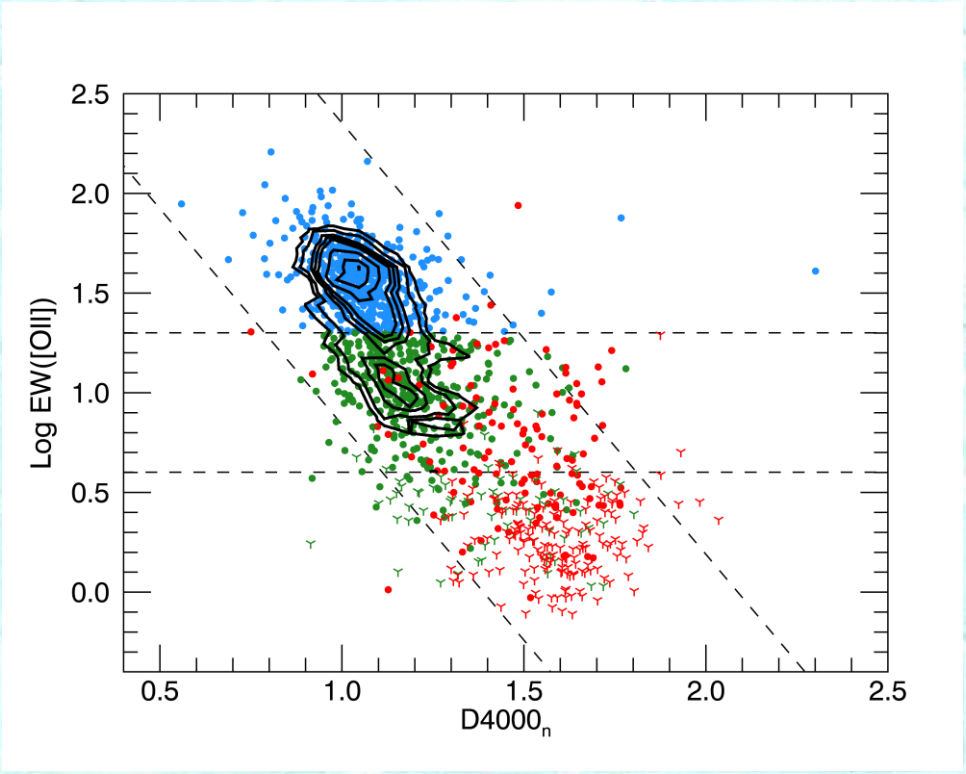


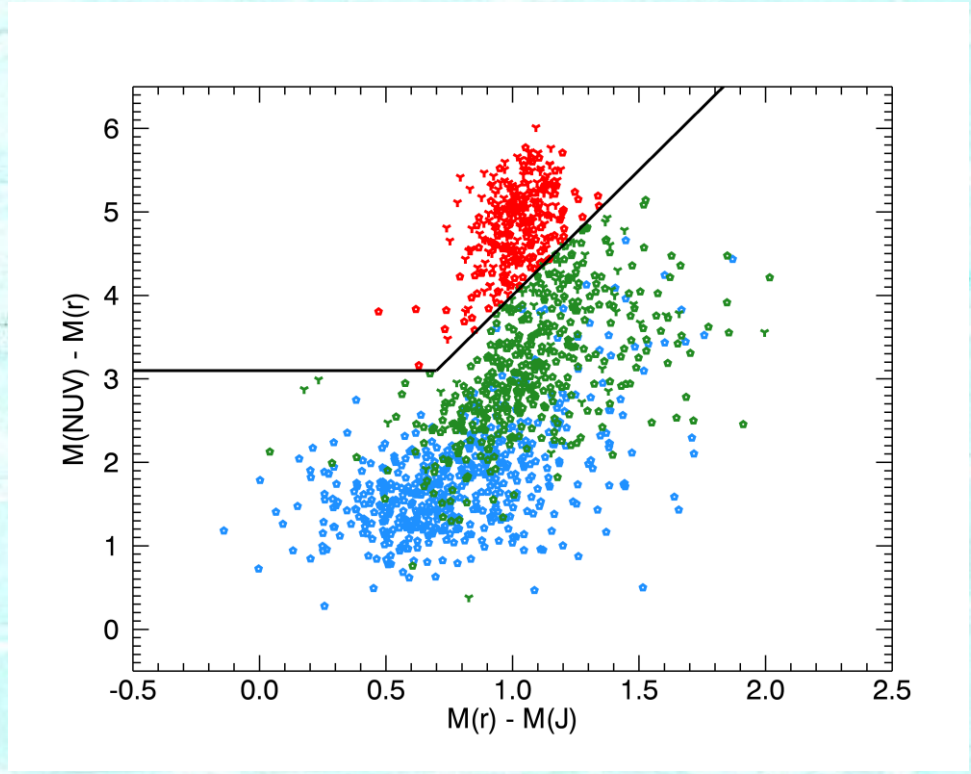


SF galaxies the galaxies that have EW([OII]) > 4.

SFR from [OII] using Moustakas et al 2006 that removes the systematic effects of reddening

Intermediate galaxy population

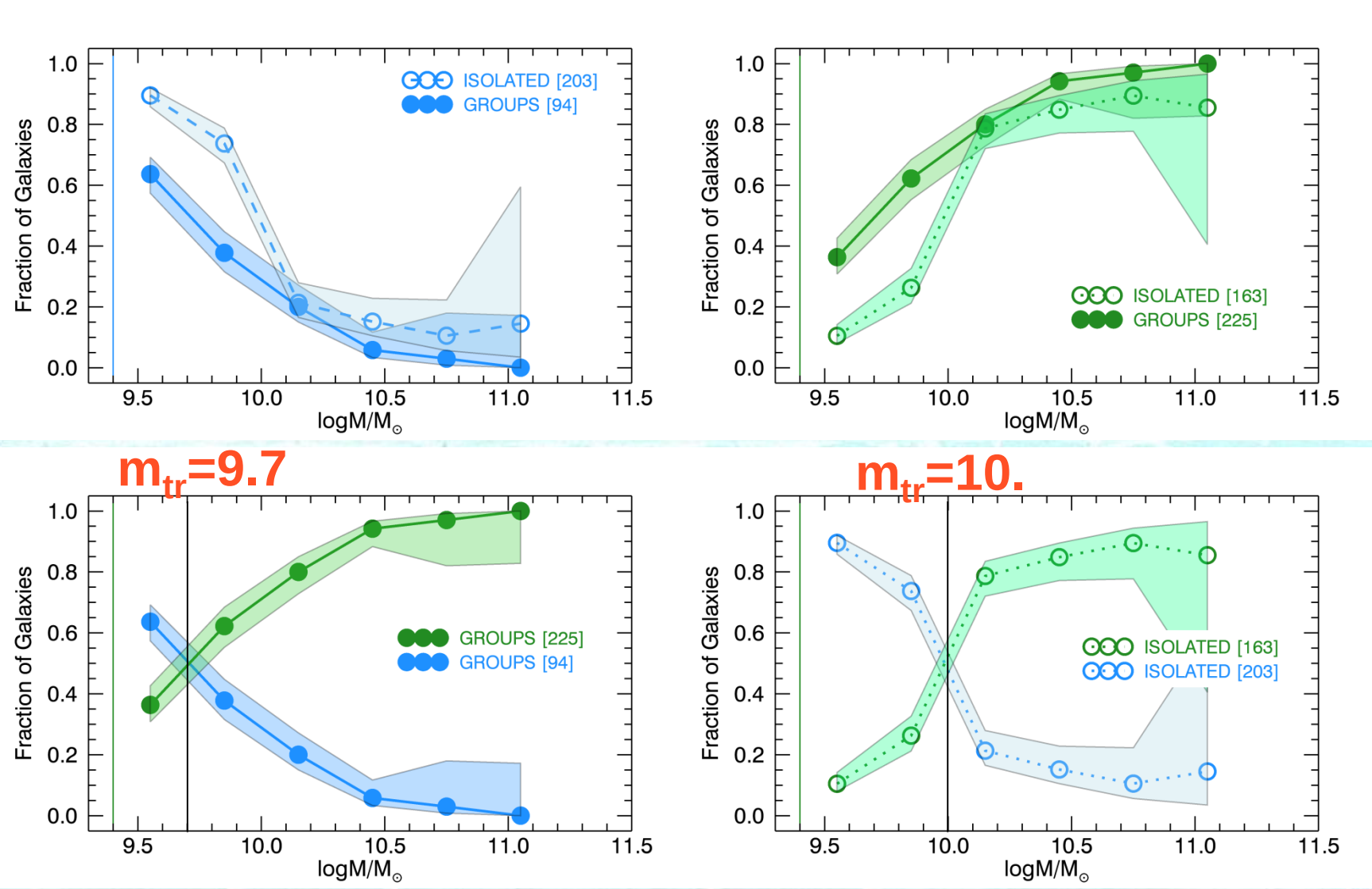




The green galaxies: classified as blue from the NUVrJ diagram and have EW([OII])<20 A

Fraction of blue-green galaxies

f(color) f(mass) f(environment)



Fraction of blue-green galaxies

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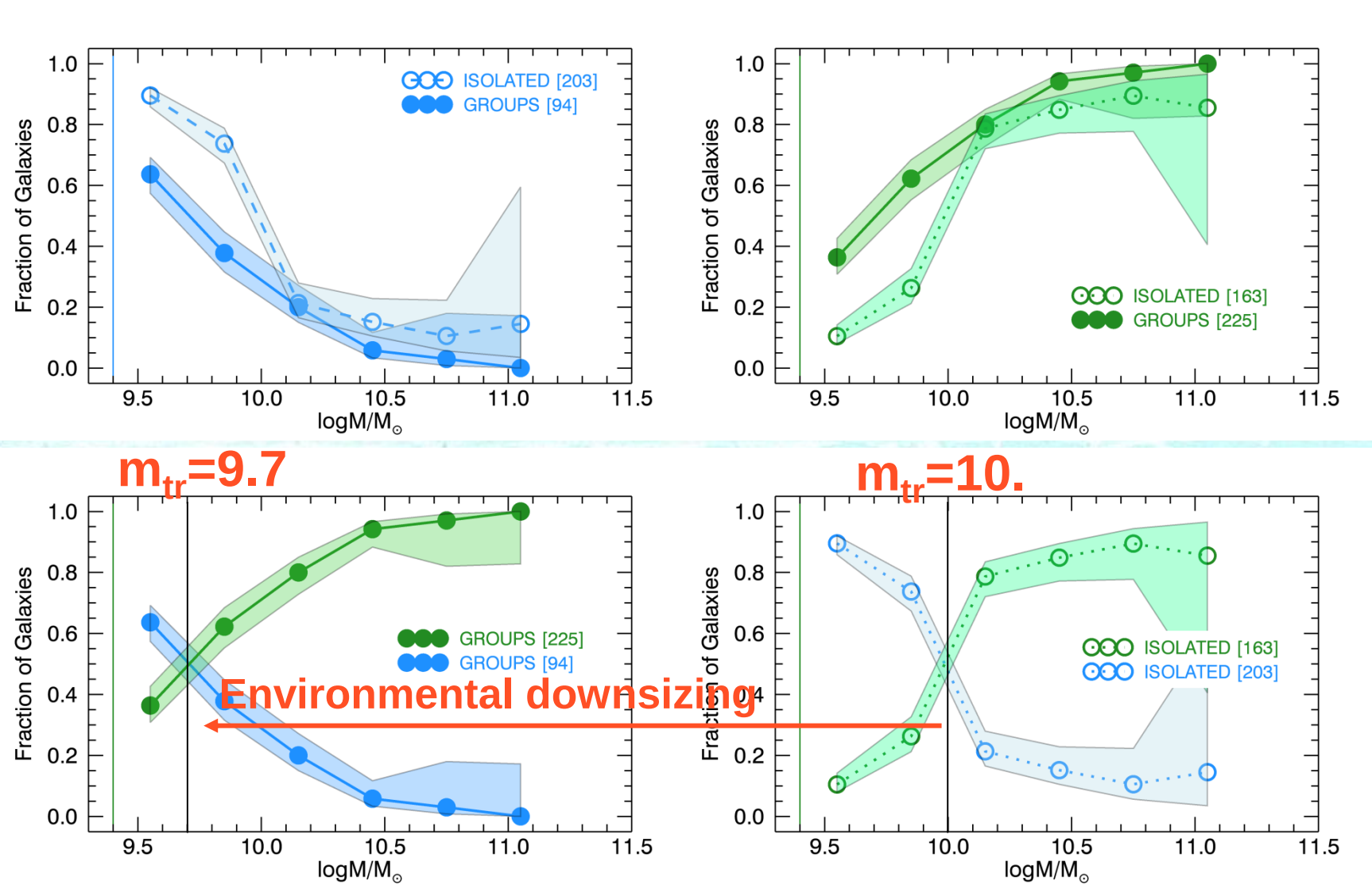

Fraction of blue-green galaxies

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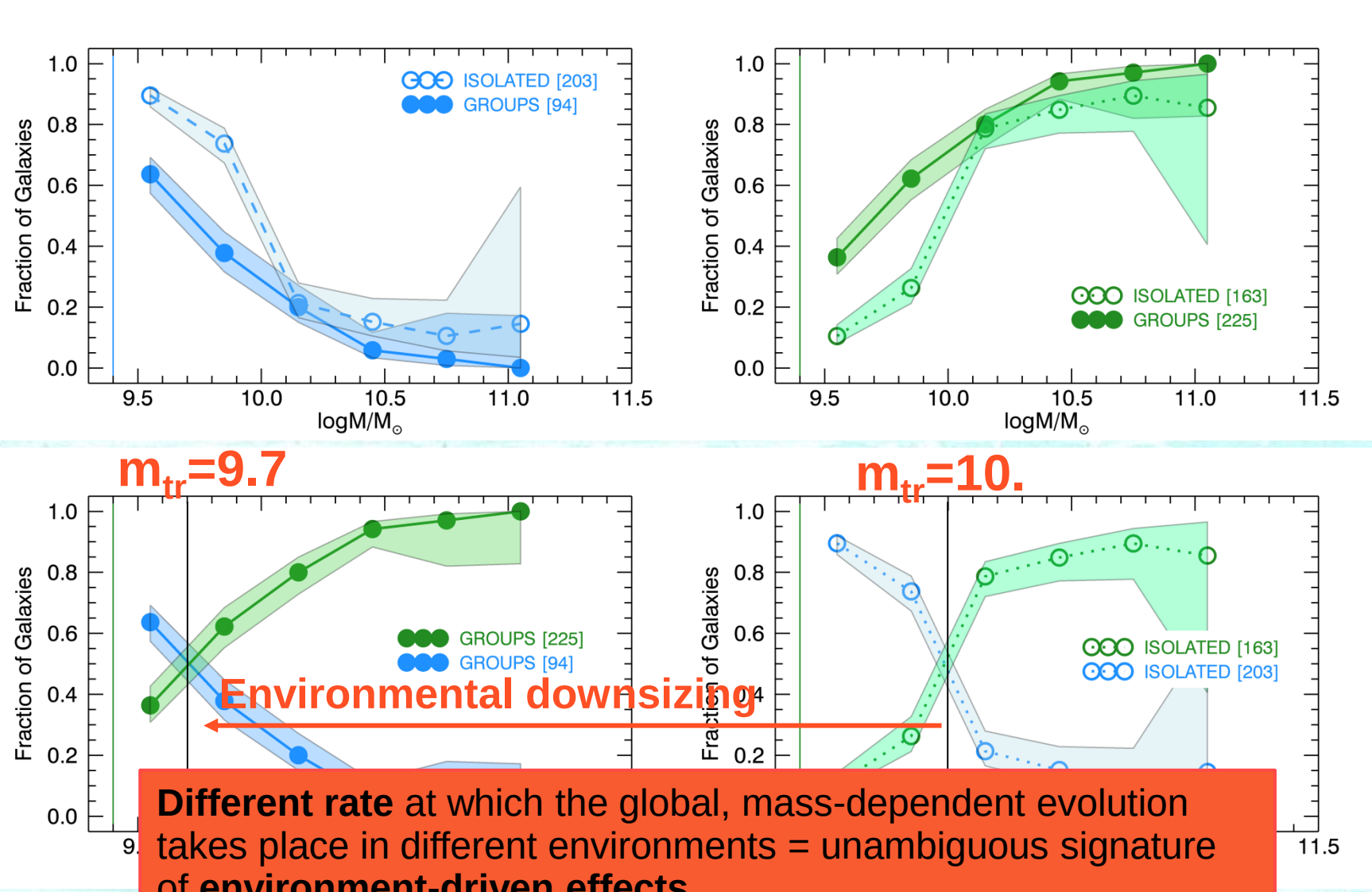
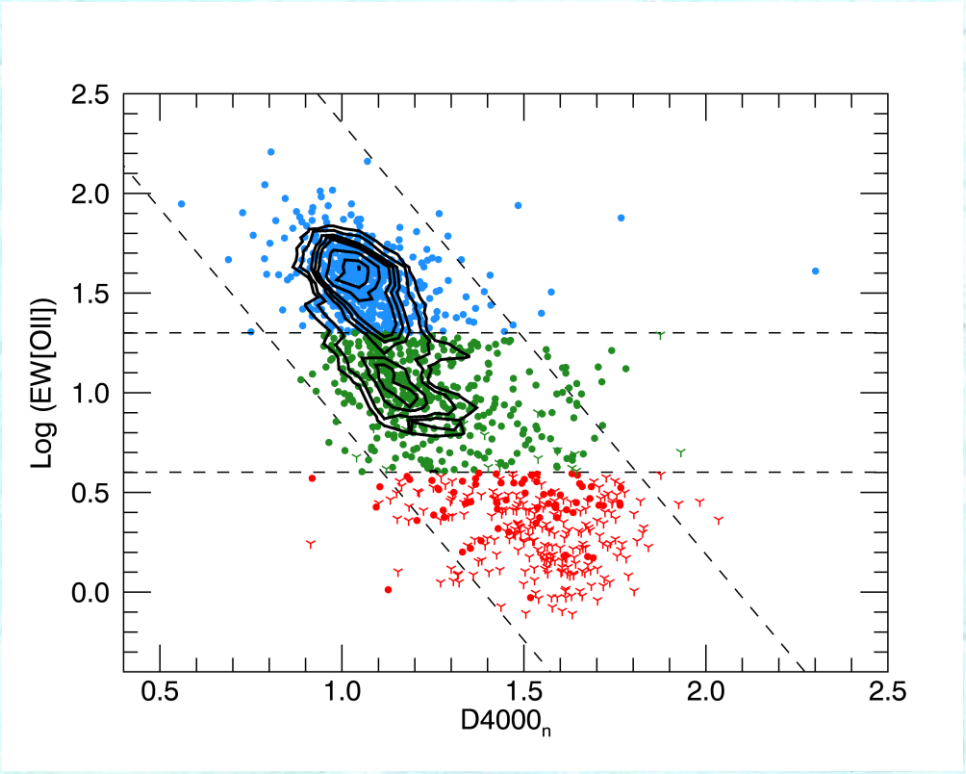
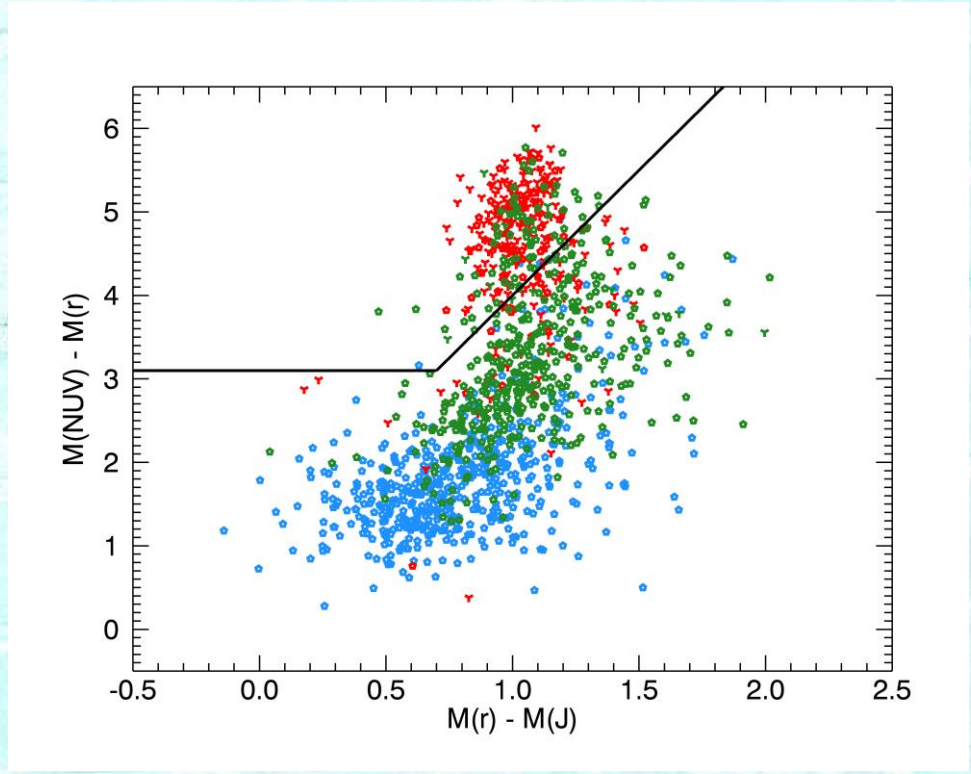


Different rate at which the global, mass-dependent evolution takes place in different environments = unambiguous signature of **environment-driven effects**

Intermediate galaxy population V2

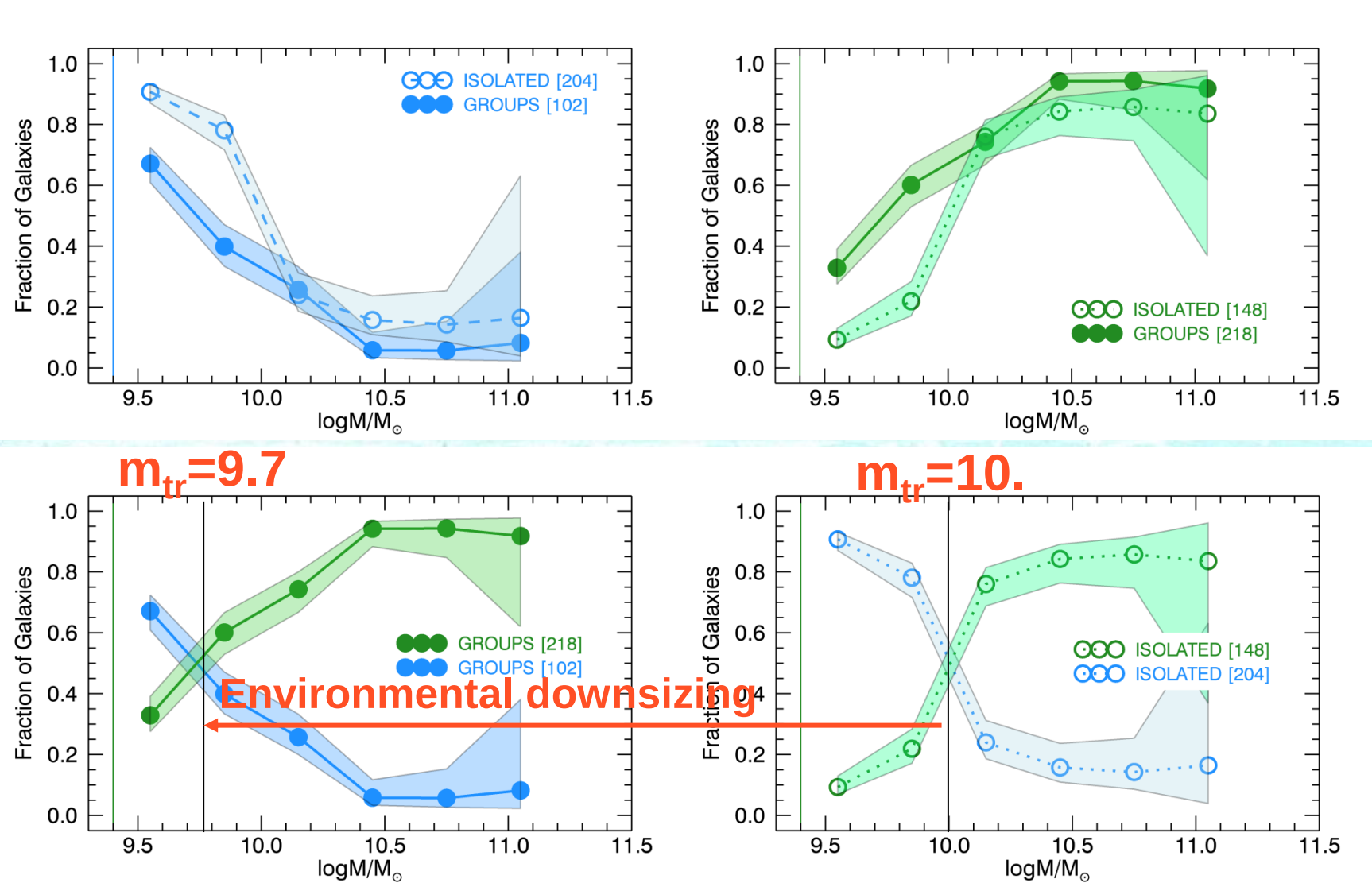




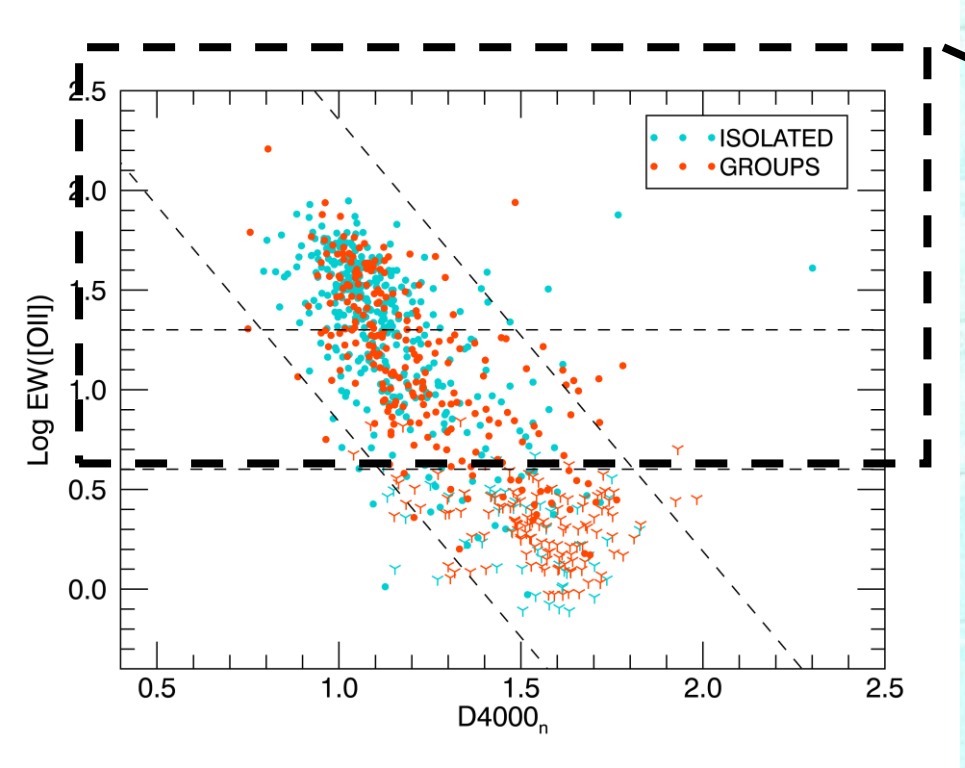
Green galaxies: 4.<EW([OII])<20.
Blue galaxies: EW([OII])>20.

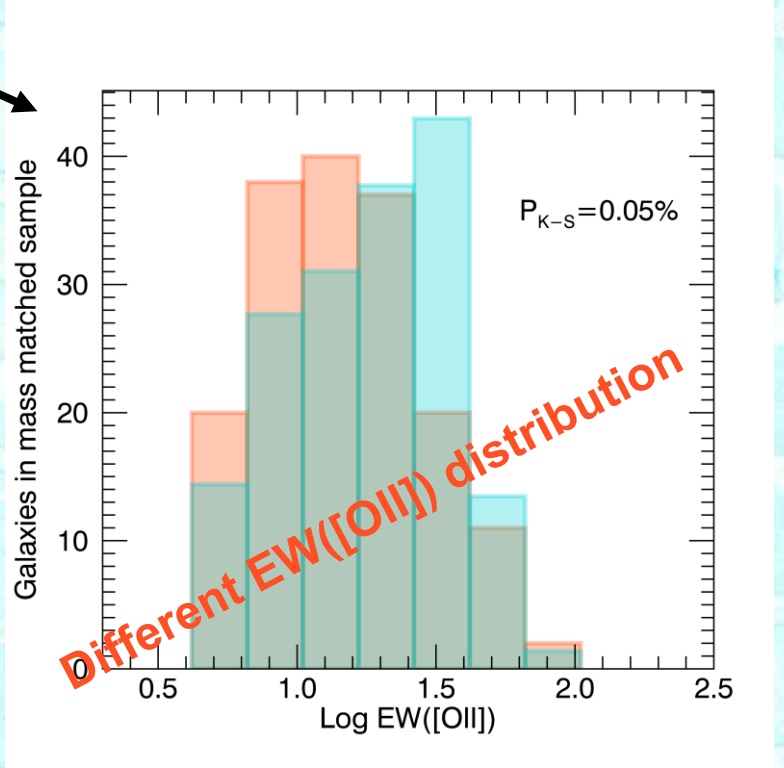
Fraction of blue-green galaxies

f(color) f(mass) f(environment)



SF galaxies vs Environment



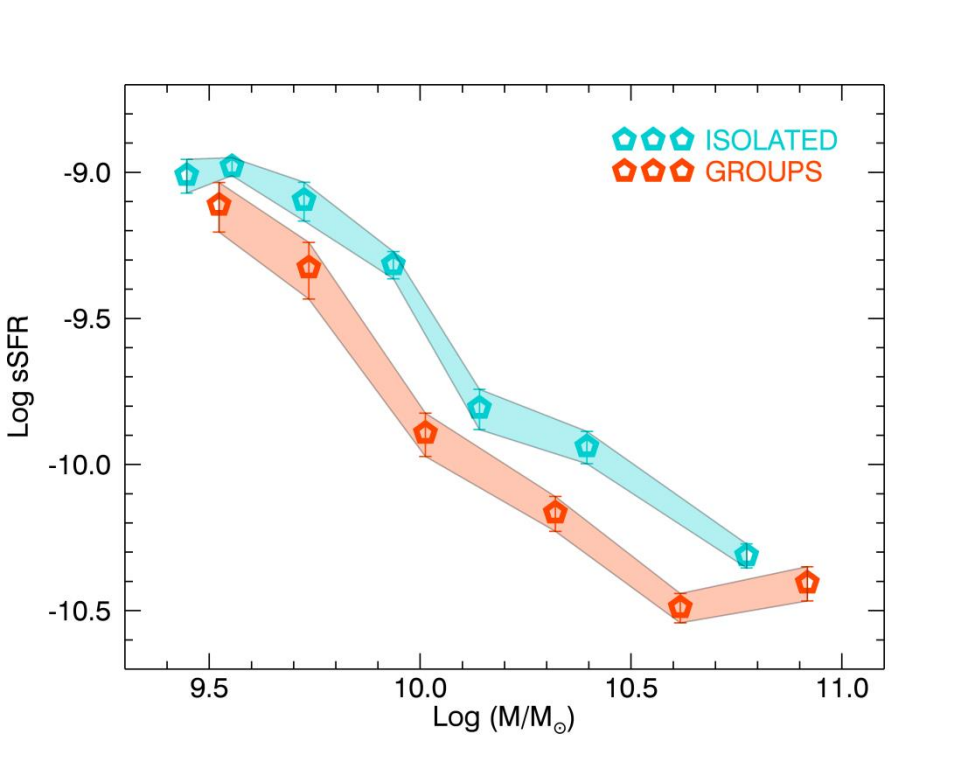


We compare mass-matched samples of

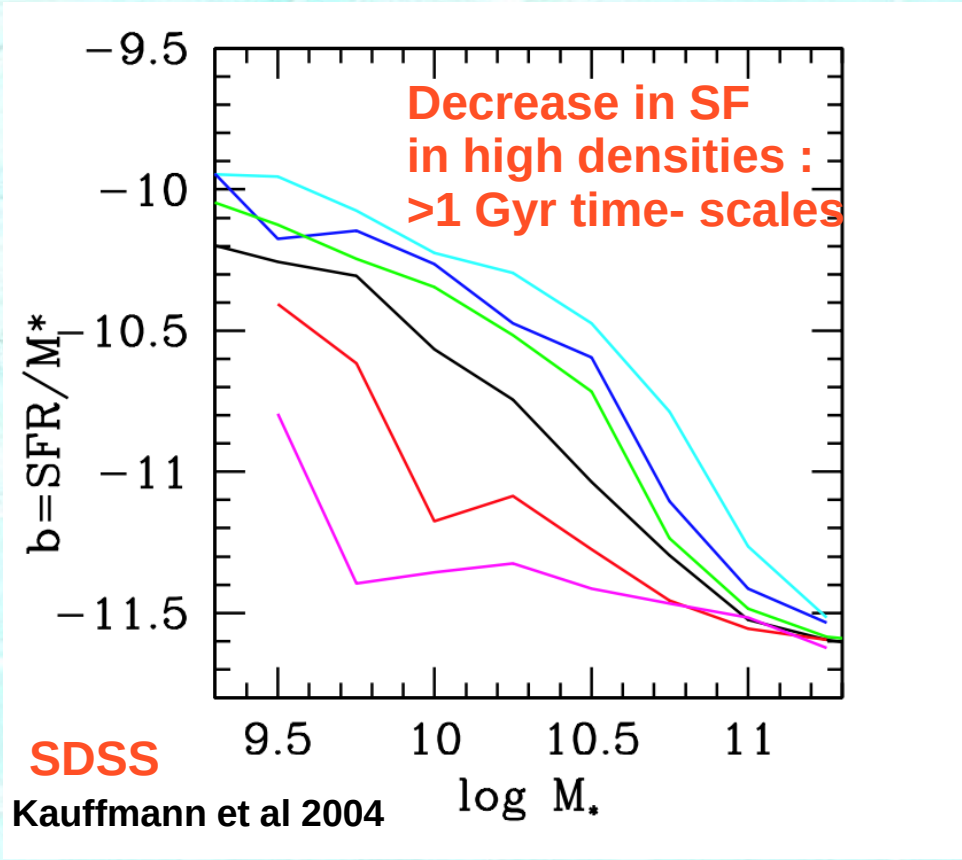
- SF galaxies in groups and
- SF isolated galaxies

sSFR vs Environment

We compare the median sSFR of the **star-forming galaxies** in different environments



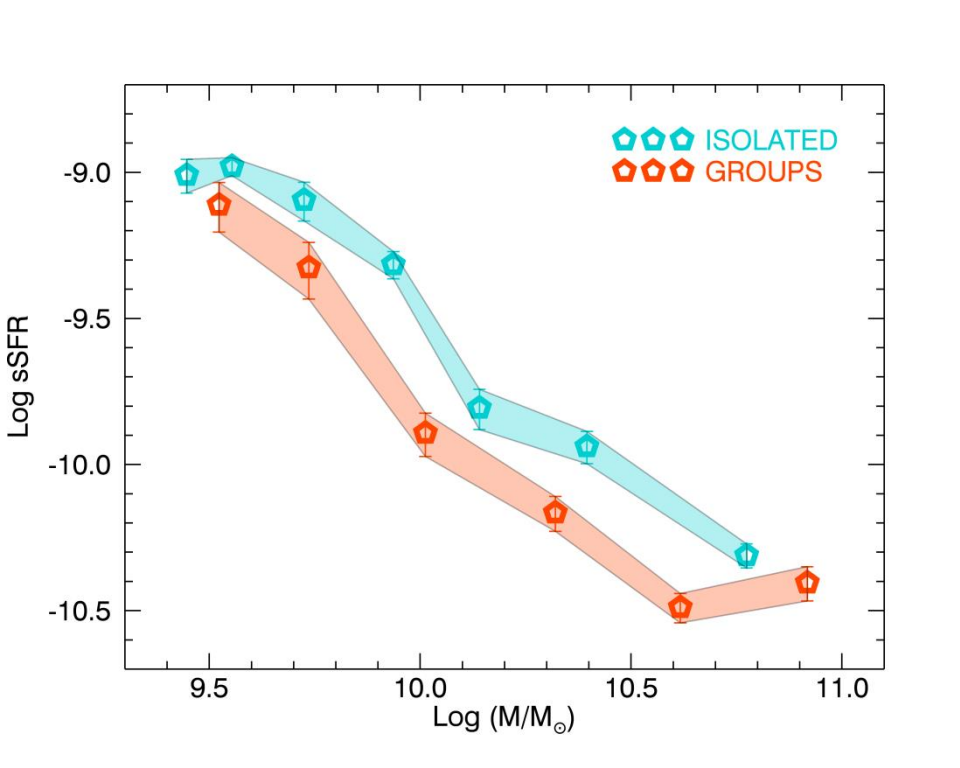
@z=0.7 SF galaxies in groups show lower typical SSFR

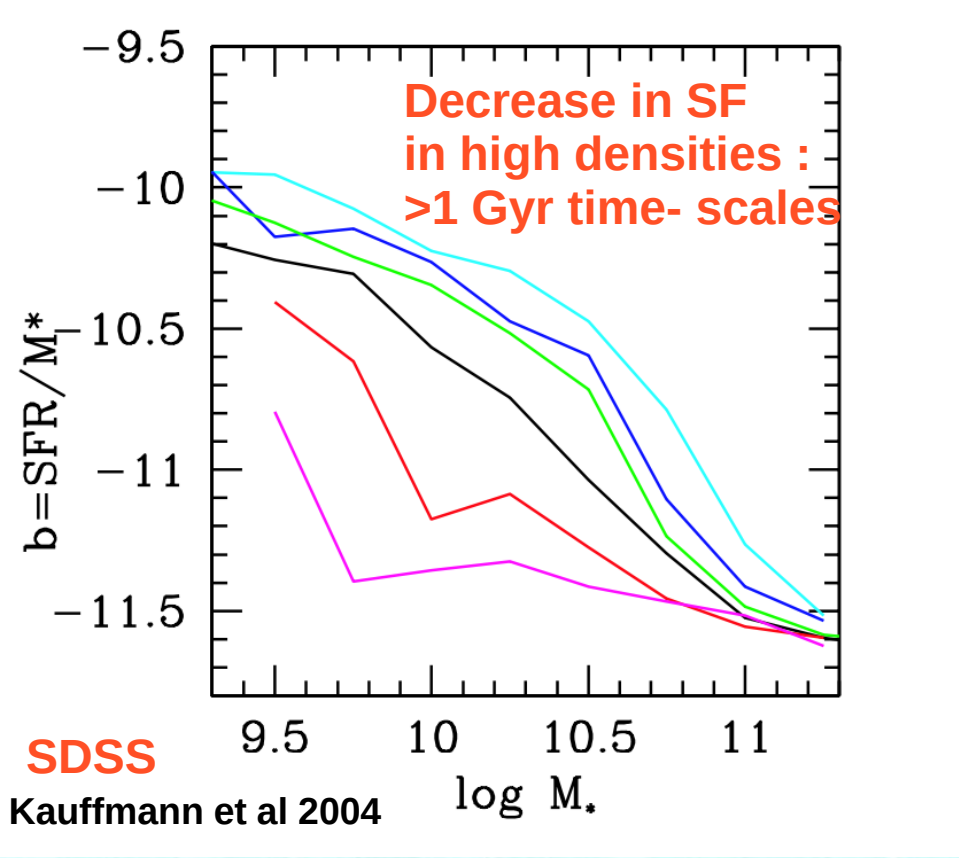


See also **Scoville et al. 2007 & 2013**, & **Patel et al. 2009 & 2011**

sSFR vs Environment

We compare the median sSFR of the **star-forming galaxies** in different environments





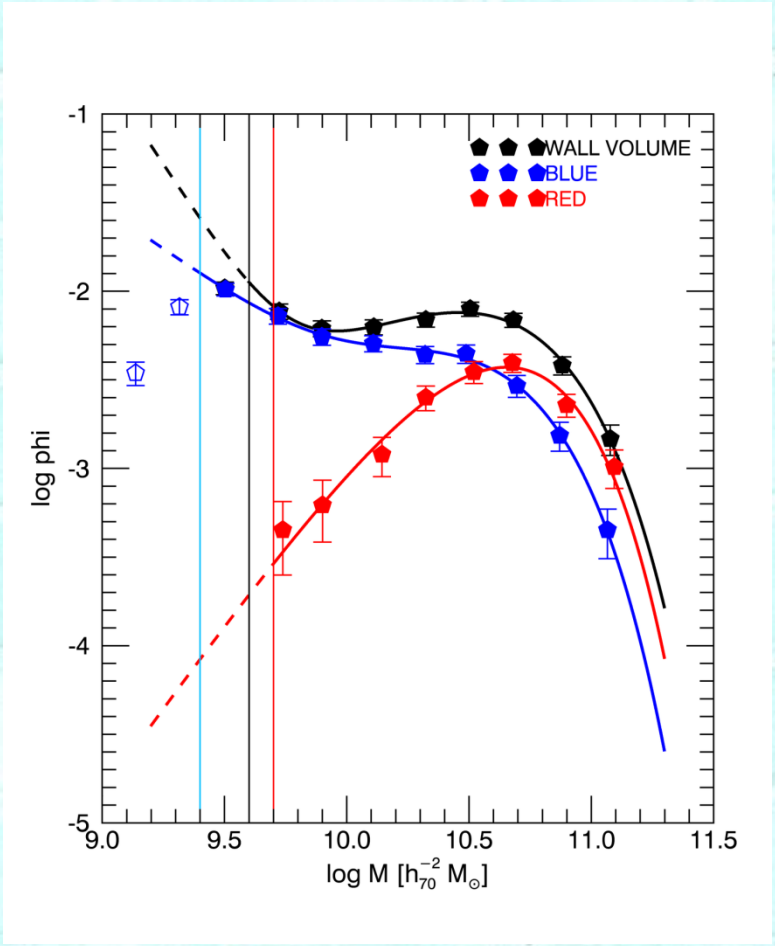
@z=0.7 SF galaxies in groups show lower typical SSFR

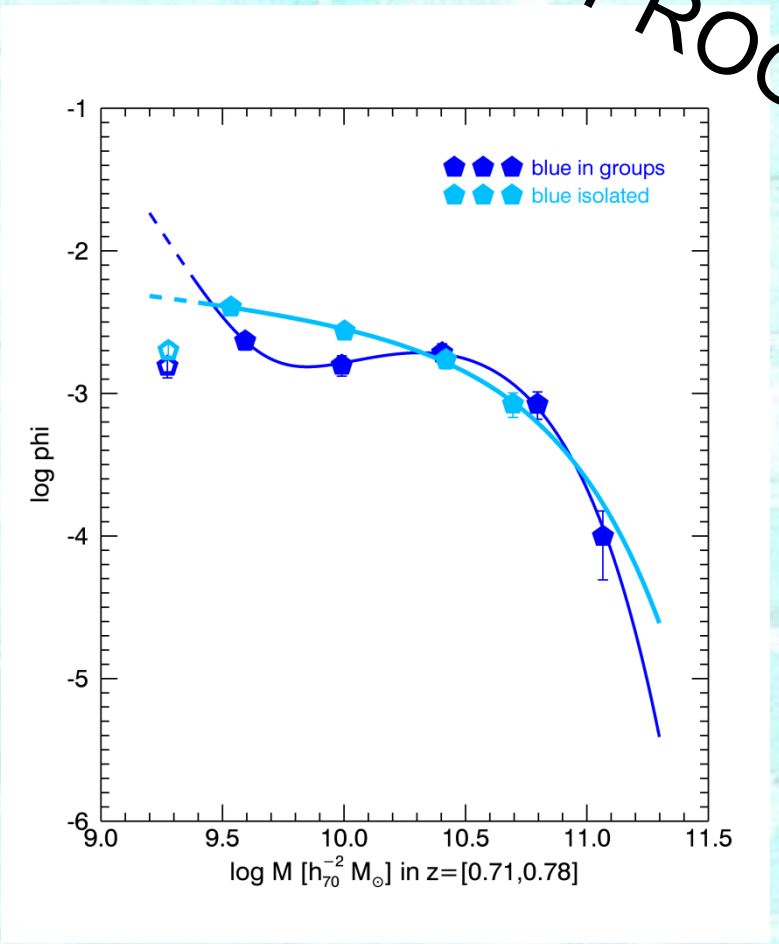
See also **Scoville et al. 2007**, **Patel et al 2009 & 2011**

Gradual SF decline indicating gradual shut down in the cold gas supply that fuels SF

Mass functions f(color), f(environment)

WORK IN PROGRESS





Wrap-Up...

- We study a **LSS** located within an extremely narrow redshift slice @ **z=0.73**, that extends ~ 25 Mpc and encompasses a comprehensive range of environments: from dense cluster cores, groups, filaments, & void regions
- We have assembled a statistically robust and **mass-complete spectroscopic sample** down to an order of magnitude lower mass limit than that reached by zCOSMOS
- We have observed the **environmental downsizing**: as local density increases strong SF moves to galaxies with lower masses
- We have observed a **gradual decline of the SF** for galaxies located at massive haloes