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The ultimate XMM extragalactic survey

die Kunst über in der Wissenschaft

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GROUPS AND CLUSTERS OF GALAXIES IN THE XXL SURVEY

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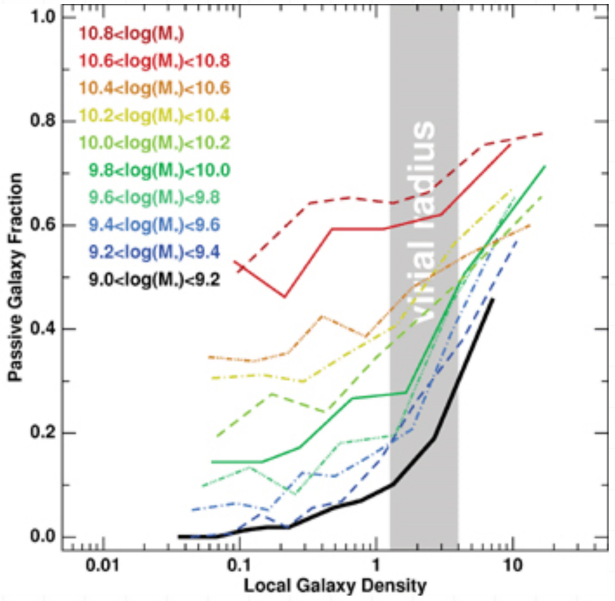
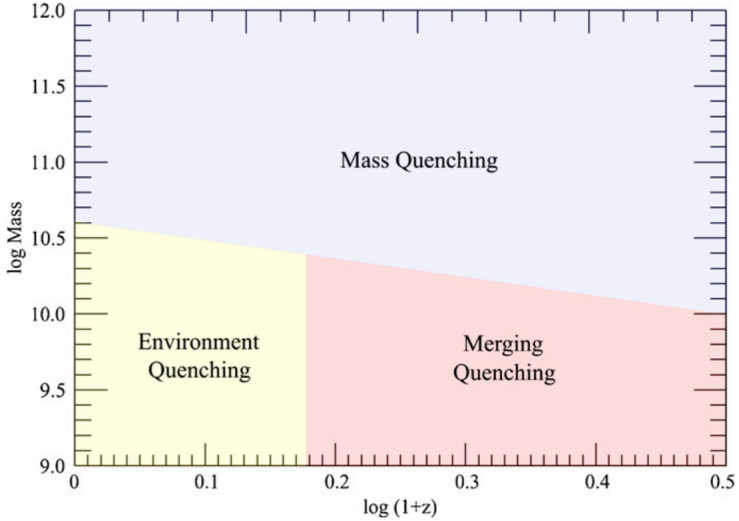
THE MAJOR DRIVERS OF GALAXY EVOLUTION

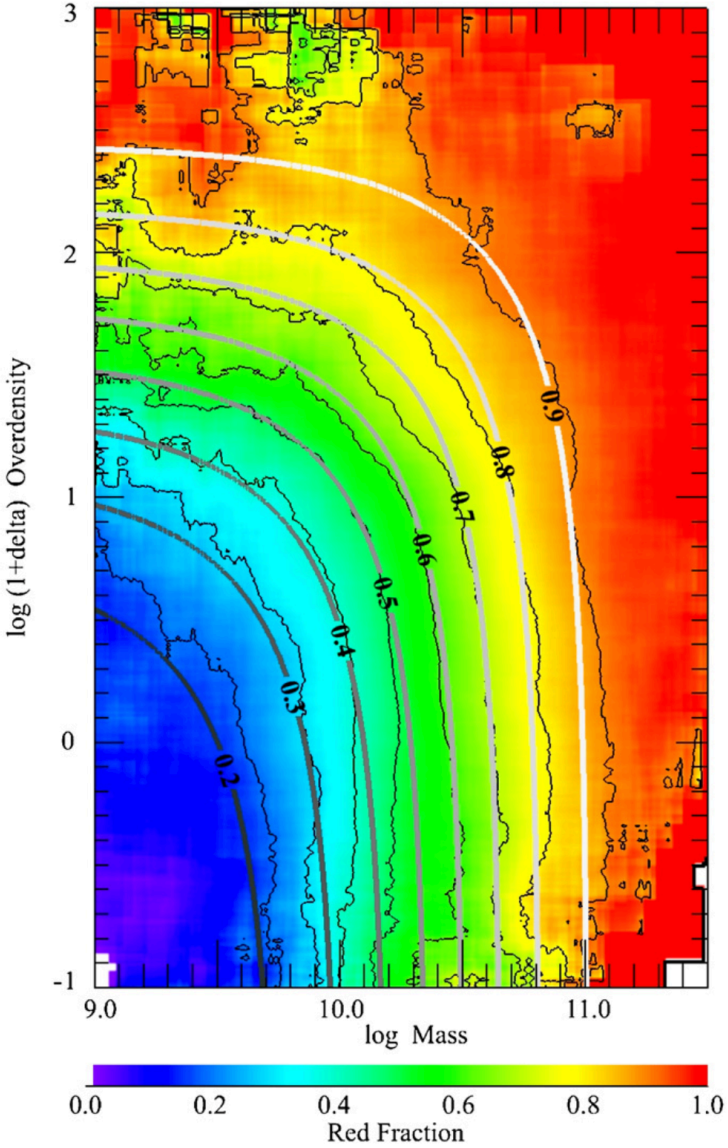


Haines+2007

NATURE
vs
NURTURE

Peng+2010





OBSERVATIONAL STUDIES IN GALAXY EVOLUTION REQUIRE

→ Sizeable galaxy samples, exploiting different redshifts.

→ Photometric and spectroscopic data.

→ Homogeneous estimates of observed and rest-frame galaxy colours, stellar masses and spectral features.

→ Consistent definition of the environment.

X X L

The ultimate XMM extragalactic survey

Pierre+2016, http://irfu.cea.fr/xxl

die Kunst über in der Wissenschaft

WHAT:

~622 XMM pointings covering a total area of ~ 50 deg^2 (N+S Fields) reaching a sensitivity of ~ 5×10^{-15} erg s^{-1} cm^{-2} in the [0.5-2] keV band for point sources.

WHY:

- Wide area in the sky → diminishing the cosmic variance.
- Groups and clusters (G&C) confirmed spectroscopically.
- $2.27 \times 10^{41} \leq L^{XXL}_{500}$ (erg sec^{-1}) $\leq 3.18 \times 10^{44}$.
- $1.24 \times 10^{13} \leq M_{500}(M_\odot) \leq 6.64 \times 10^{14}$.

THIS WORK:

132 XXL-N G&C M_{500}, R_{500}, $L_{X\text{-}ray}$, $T_{X\text{-}ray}$ both from direct measurements and scaling relations.

+

Unprecedented combination of information on the G&C intergalactic gas (X) with galaxy photometry and spectroscopy.

GOAL:

Investigate the properties of galaxies at intermediate redshift ($0.1 \leq z \leq 0.6$) and assess the role of environment on the galaxy stellar mass assembly and star formation activity.

1) Build and characterize the **spectrophotometric sample** of galaxies

2) The **Galaxy stellar mass function (GSMF)** in different environments and at different redshifts

3) Zooming in a **supercluster @z=0.3**: Stellar population properties and star formation activity

4) The **star forming fractions and SFR-mass relation** from **z=0.1 up to z=0.5**.

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XXL PAPER XXII: A COMPLETE CHARACTERIZATION OF XXL-N GALAXIES

Guglielmo+2017.

The catalogue is going to be released at CDS

24336 galaxies

- ✓ $z \leq 0.6$
- ✓ Group membership:

22111 (29683) in the field.
2225 (3446) 3 r_{200} members.

- ✓ Photometry from CFHTLS-W1 field: u*,g',r',i',z'.
- ✓ Completeness weight and magnitude limit $r \leq 20.0$
- ✓ Stellar Masses and Absolute Magnitudes from LePhare (95.5%)

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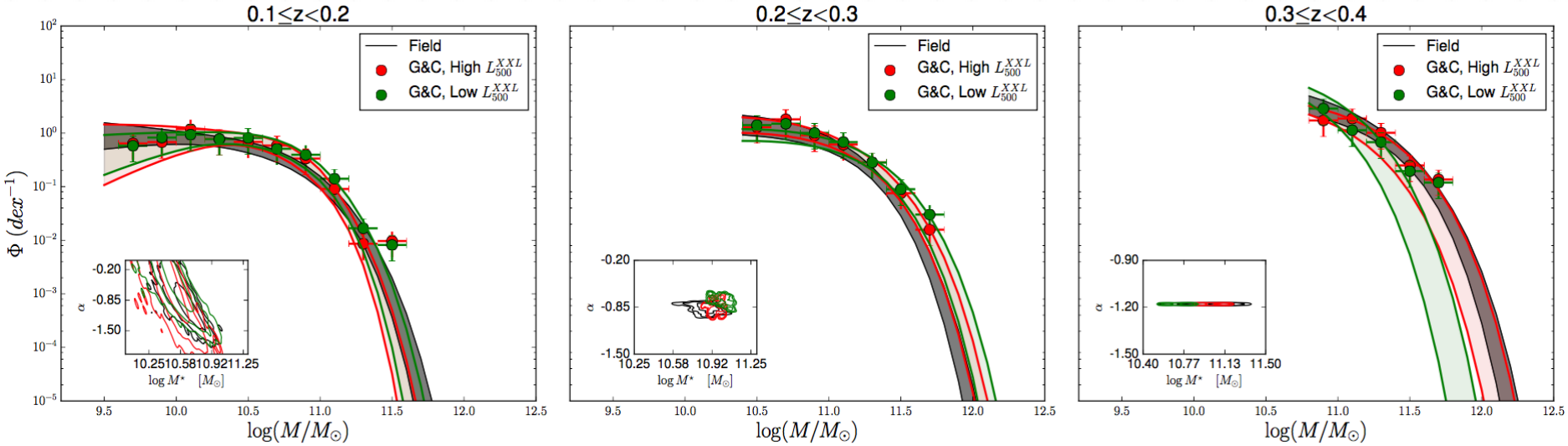

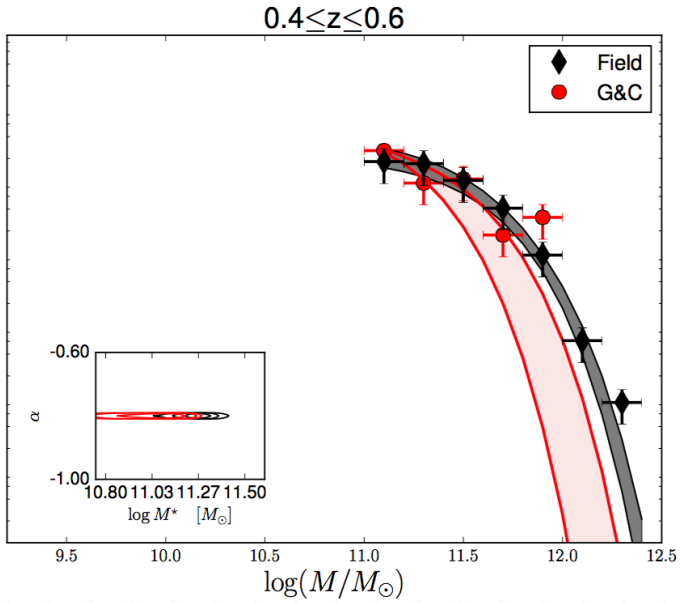

Guglielmo et al. 2017
XXL Paper XXII

SCARCE DEPENDENCE ON THE ENVIRONMENT

(Field vs G&C, High/Low $L_{X\text{-ray}}$)

No significant correlation also between G&C $L_{X\text{-ray}}$ and the mean mass of member galaxies.

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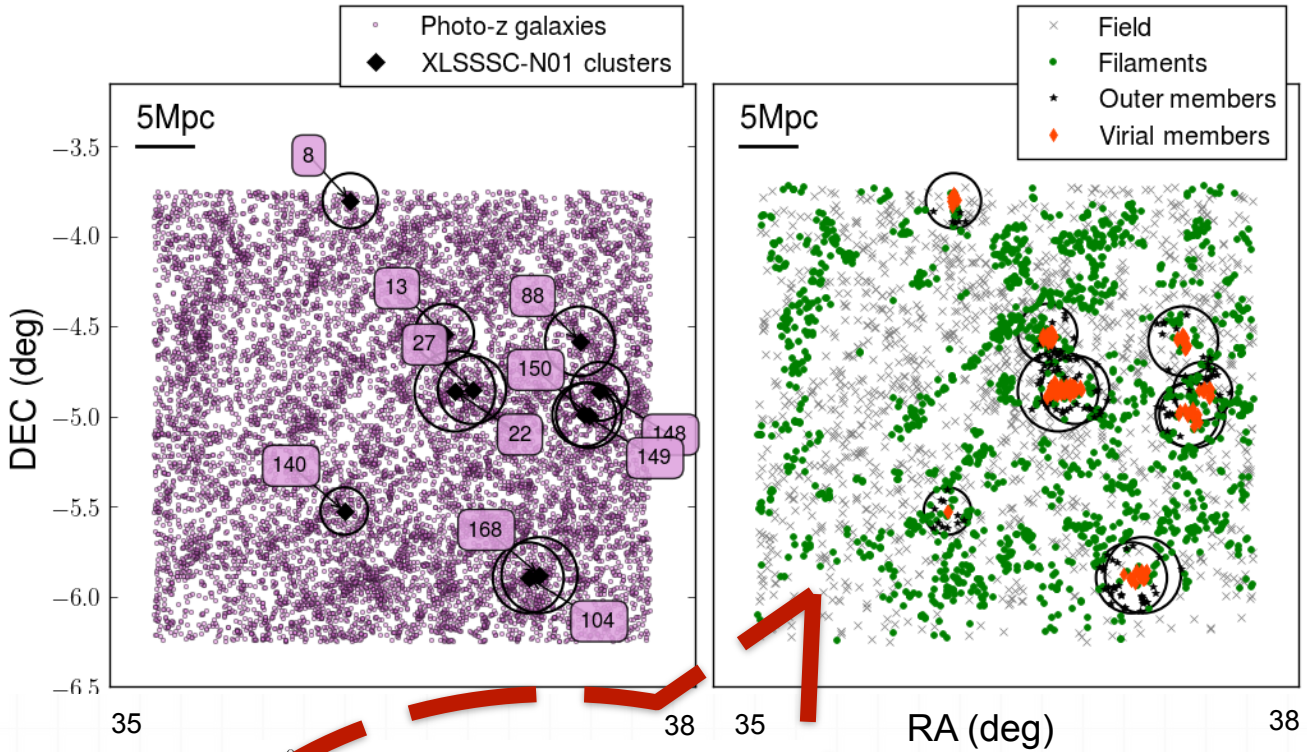
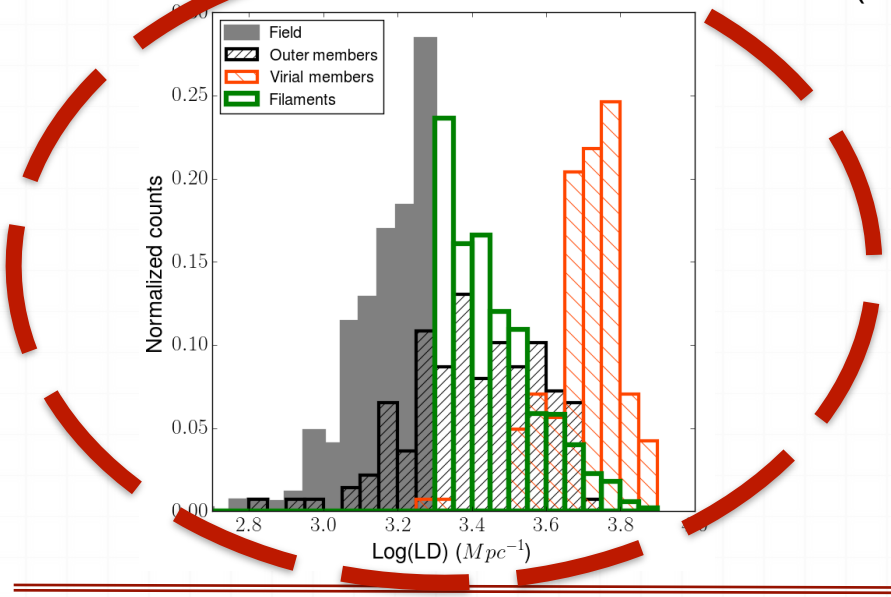
THE XLSSsC N01 SUPERCLUSTER

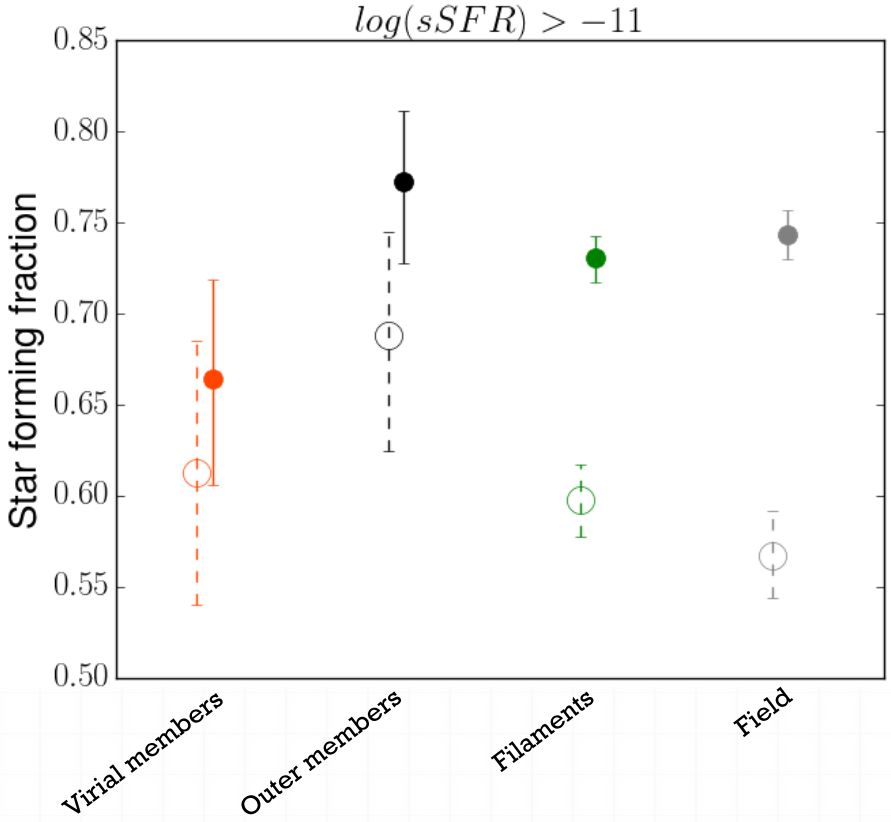




RA = 36.954
DEC = -4.778
z = 0.2992
#G&C = 11 (14)
#member galaxies = 143 (vir) + 145 (out)

The star forming fraction In XLSSsC N01 supercluster

Guglielmo et al. to be submitted
XXL Paper XXX



SFR, LW-age, Mass
From full spectral fitting
(SINOPSIS: Fritz+2007,2011,2014,2017)

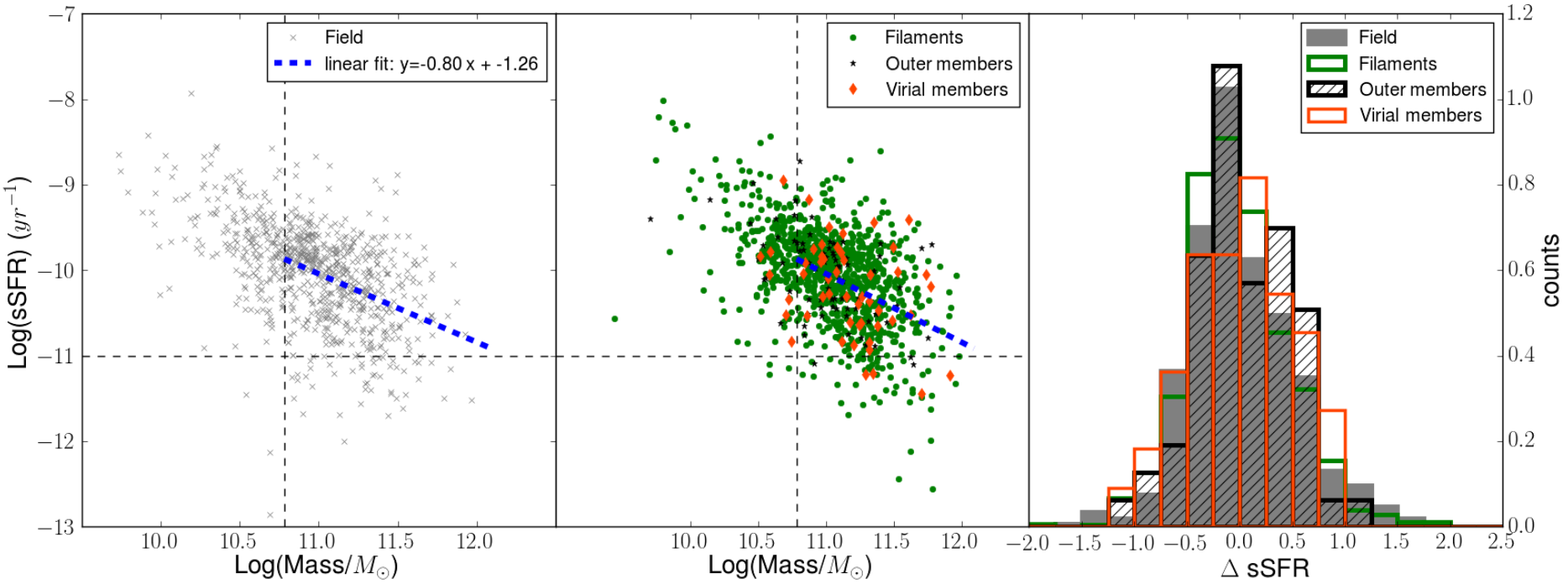
Magnitude limited sample
(r≤20.0)

Mass limited sample
($M \geq 6.0 \times 10^{10} M_{\odot}$)

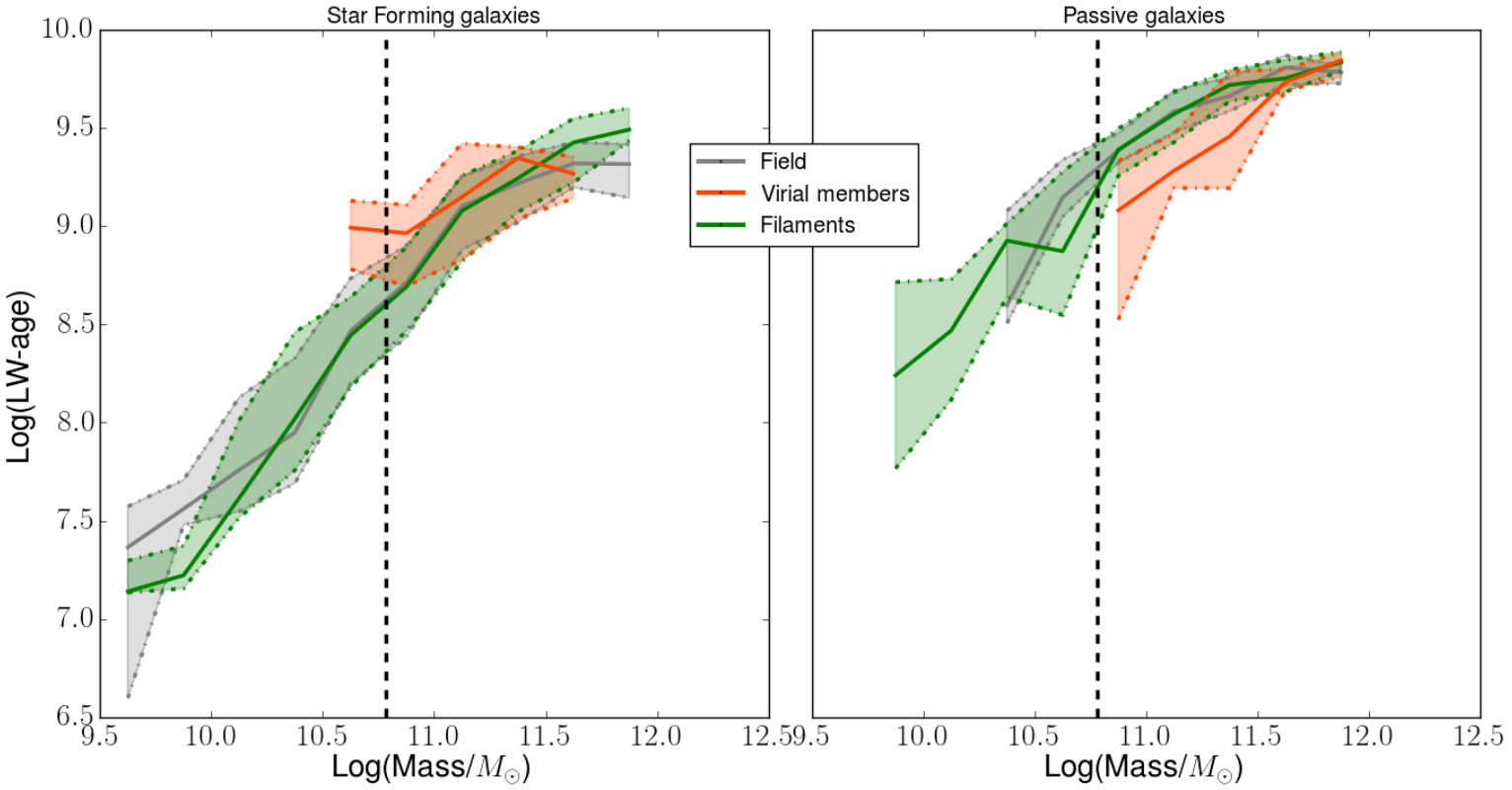
See also Bai+2007, Fadda +2008, Santos+2013

Similar trends using rest-frame colours

The sSFR-Mass relation shows no dependence on environment In XLSSsC N01 supercluster



The LWage-Mass relation in different environments
In XLSSsC N01 supercluster



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- Galaxies in the XXL-N field @ $0.1 \leq z \leq 0.5$ (three redshift bins).

- Field, Outer and Virial members.

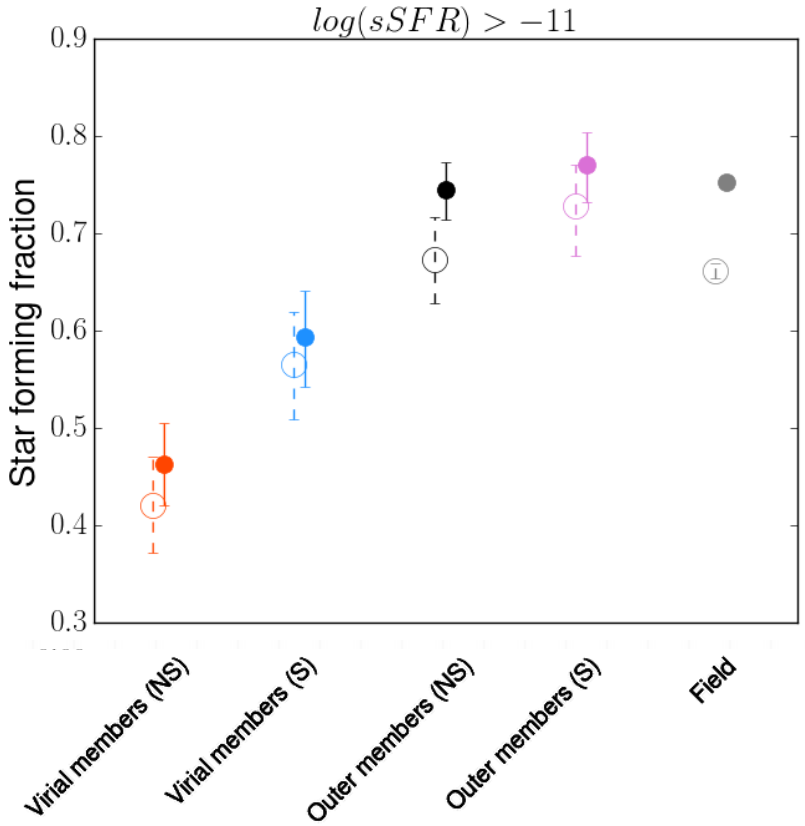
- Superclusters from Adami et al. 2017.

- Full spectral fitting for deriving star formation properties and ages.

4) The **star forming fractions and SFR-mass relation** from **z=0.1 up to z=0.5**.

Guglielmo et al. in prep.

The SF fraction and the SFR-Mass relation at $0.2 \leq z < 0.3$



- Magnitude limited sample ($r \leq 20.0$)
- Mass limited sample ($M \geq 6.0 \times 10^{10} M_{\odot}$)

- Similar trends using rest-frame colours
- No dependence on X-ray luminosity

Guglielmo et al. in prep.

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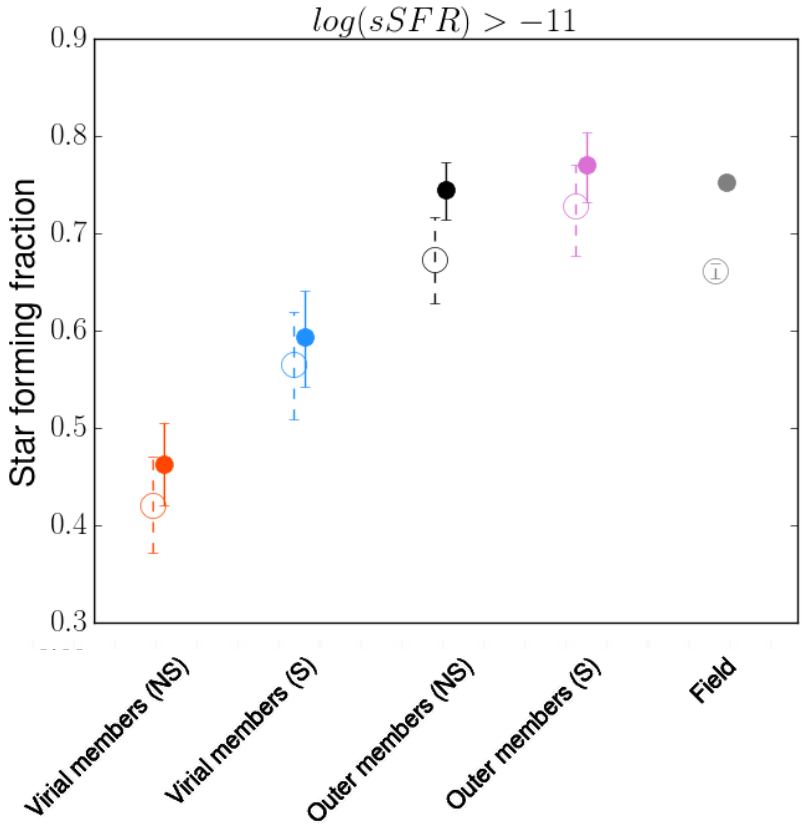
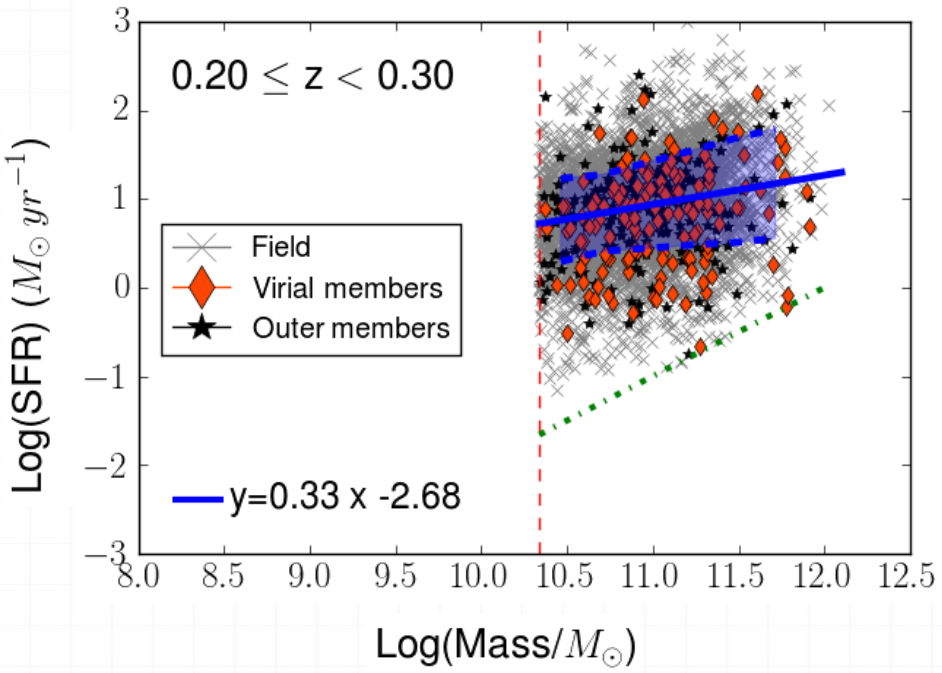




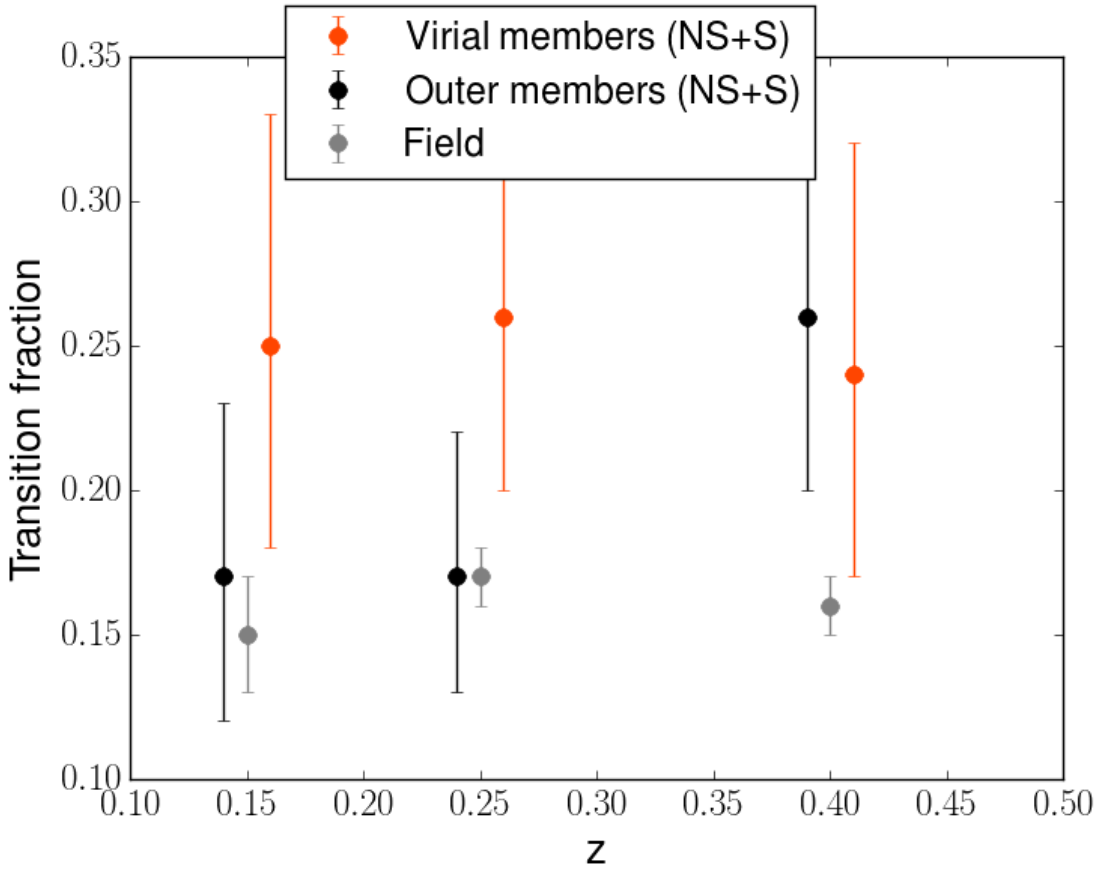
- sSFR-Mass varies with environment.

- Transition galaxies:
Field: 17%
Virial Members: 30% (19% in S)
Outer Members: 18% (10% in S)

- Similar trends using rest-frame colours
- No dependence on X-ray luminosity

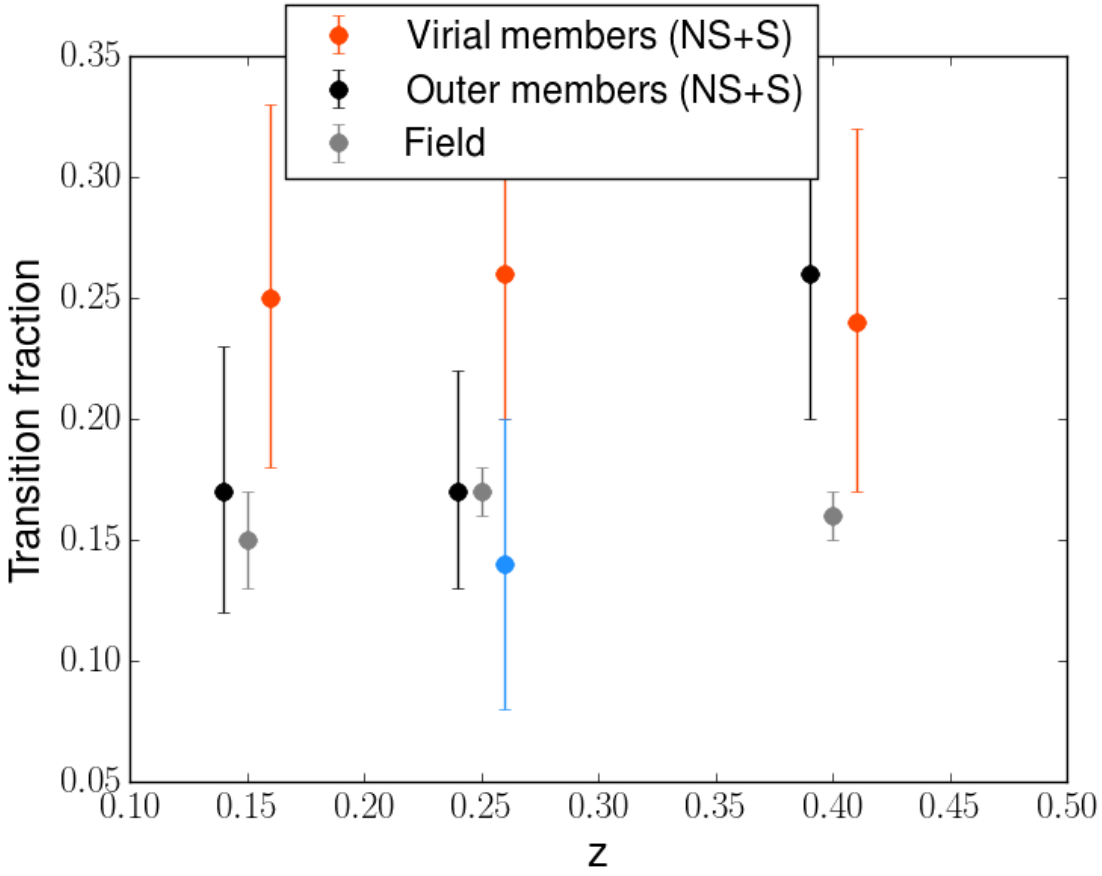
Guglielmo et al. in prep.

Transition fractions from z=0.5 down to z=0.1



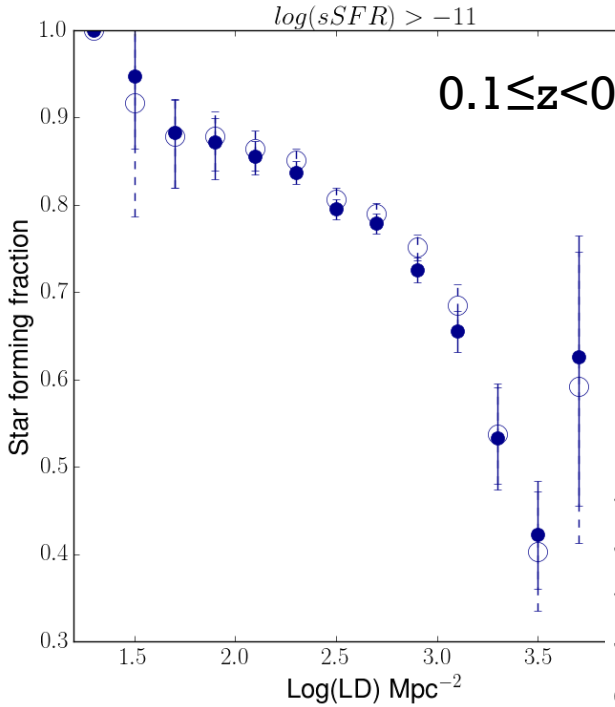
Guglielmo et al. in prep.

Transition fractions from z=0.5 down to z=0.1

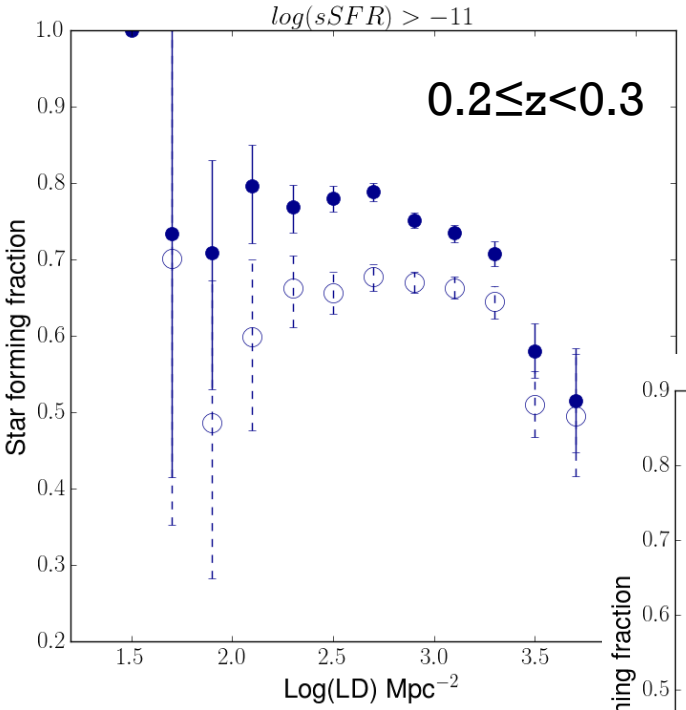


- Superclusters @0.2≤z<0.3 have the lowest fraction of transition galaxies ever.

Local environment: SF and transition fractions from z=0.5 down to z=0.1



HD: $F_{transition}$ = 0.16±0.02
LD: $F_{transition}$ = 0.17±0.02



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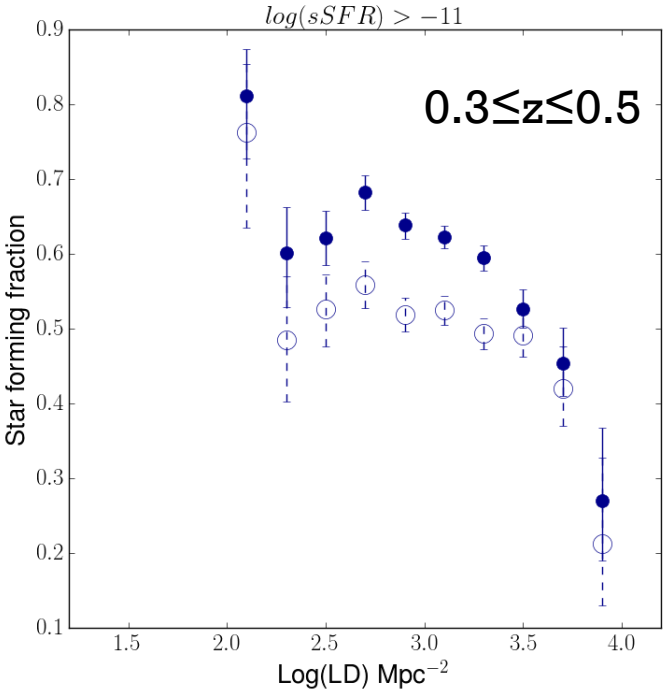

CONCLUSIONS

- ✓ No significant influence of environment-dependent processes on GSMF in the mass range we are sampling.
- ✓ The fraction of star forming/blue galaxies is lower in cluster virial members than in all other environments at all redshifts (Wetzel et al. 2012 @low-z). **Differences are smoothed at high stellar masses.**
- ✓ The SFR-mass relation is environment dependent: both the relation and the number of galaxies in transition increase in the virial regions of G&C with respect to the field at all redshifts, and is maintained nearly constant across epochs.
- ✓ The XLSSsC N01 supercluster is an exception both in the sSFR-mass relation and in the fraction of transitions.
- ✓ In XLSSsC N01 passive galaxies in clusters have lower LW-ages as a result of the recent truncation of their SF-activity in cluster environment.
- ✓ Study the ages, the star formation history, the mass assembly history of galaxies as a function of *global* and *local* environment (see also Guglielmo et al. 2015).