The Effects of the Local Environment and Stellar Mass on Galaxy Quenching to z ~ 3

Behnam Darvish

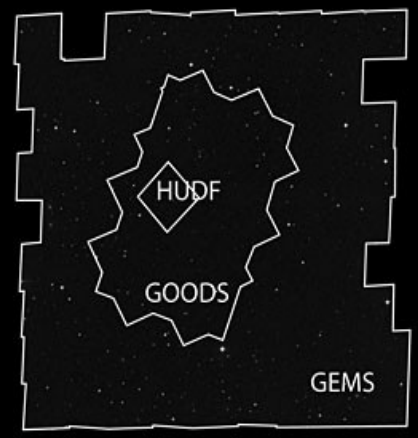
Collaborators: Bahram Mobasher, David Sobral, Alessandro Rettura, Nick Scoville, Andreas Faisst, Peter Capak

galpath16, August 2016

Darvish et al. 2016, ApJ 825, 113


WHAT
HAS MADE ME
WHO I AM ?
nature
nurture
Environmental and
mass quenching,
independent of
each other?
Darvish et al. 2016, ApJ 825, 113

Data and methods



COSMOS:

~2 sq.deg., accurate photo-z catalog of galaxies with **Ks<24** and **0.1<z<3.1**

Local Density: weighted **Voroni** tessellation

SFR and stellar Mass: **SED** template fitting

NUV-r-J selection of Quiescent/SF galaxies

Six **mass-complete samples** at

0.1<z<3.1 (70,000)

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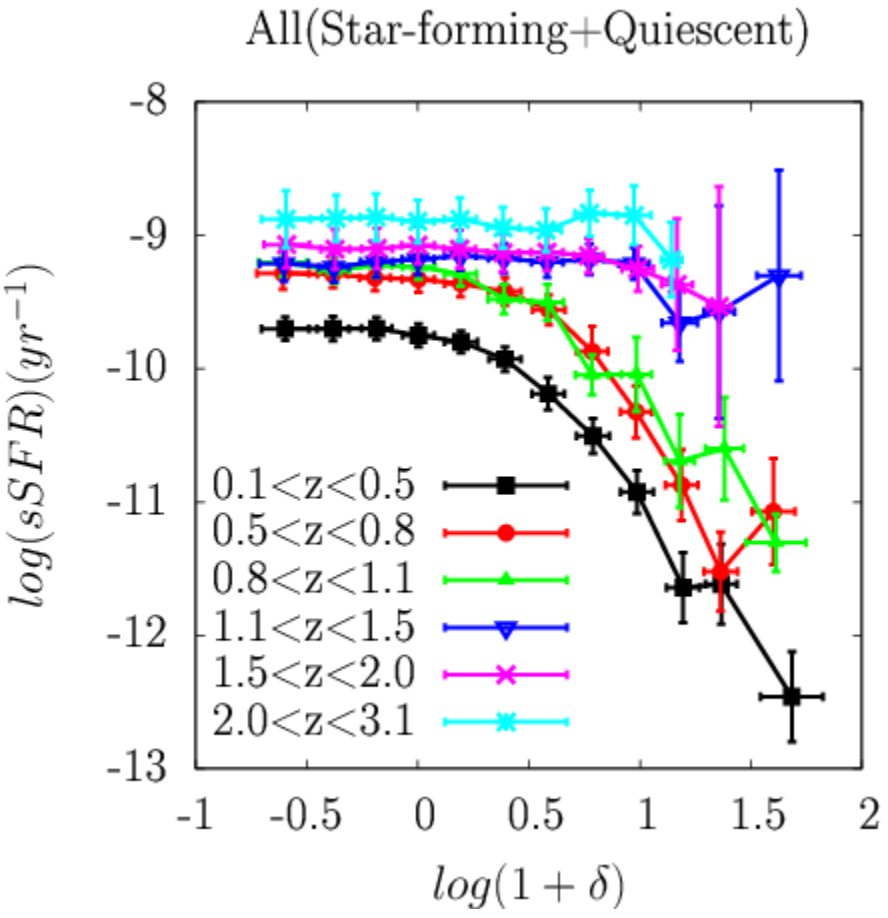
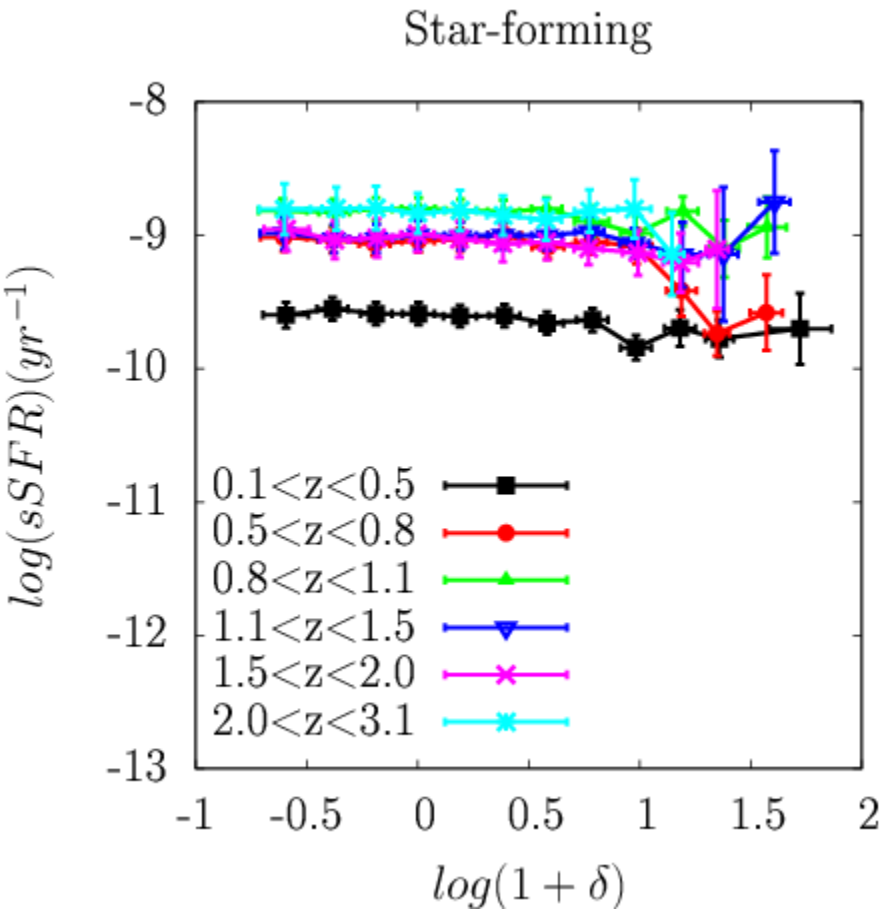
SFR and sSFR vs. Environment





- For **all** galaxies (quiescent+SF), the median **SFR** and **sSFR** depend on the environment only at **z<1**.
- For **SF** galaxies only, the median **SFR** and **sSFR** are almost independent of the environment out **to z ~ 3**.

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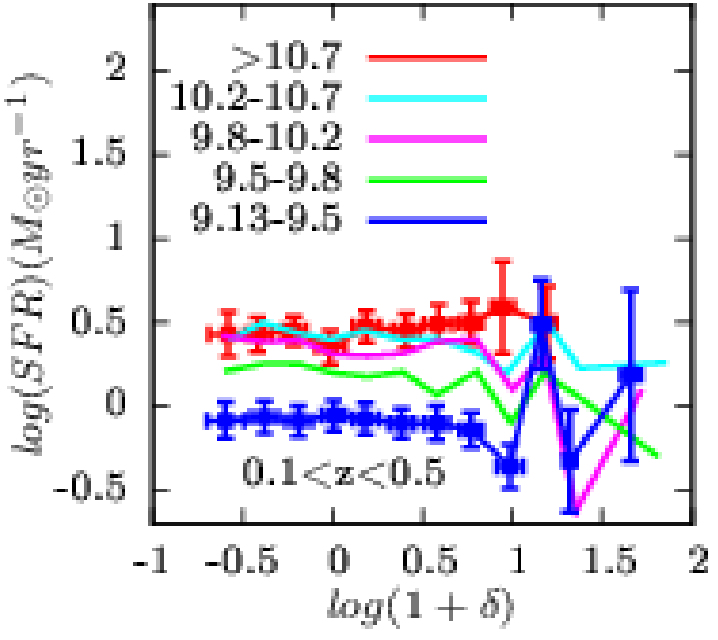
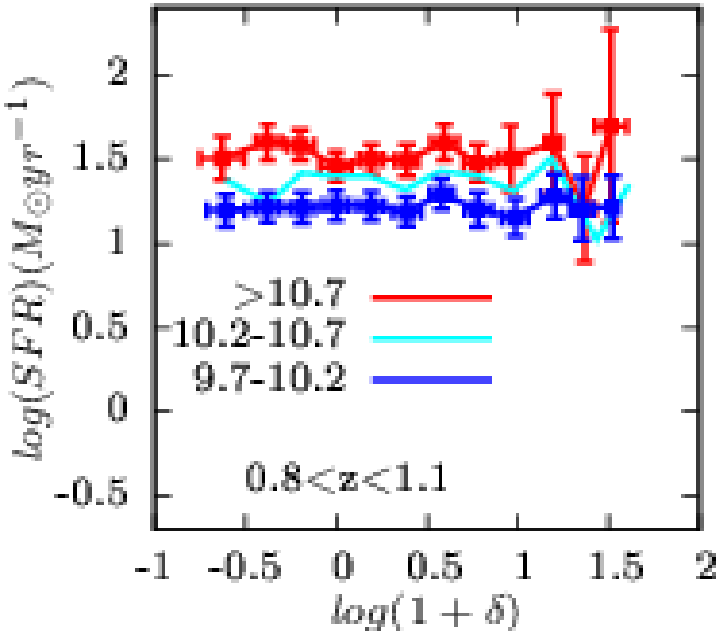
Environmental dependence of the main-sequence?





At fixed stellar mass bins, the median SFR for SF galaxies is independent of the environment but at fixed environment, it is higher for more massive SF galaxies.

No consistency in the literature?

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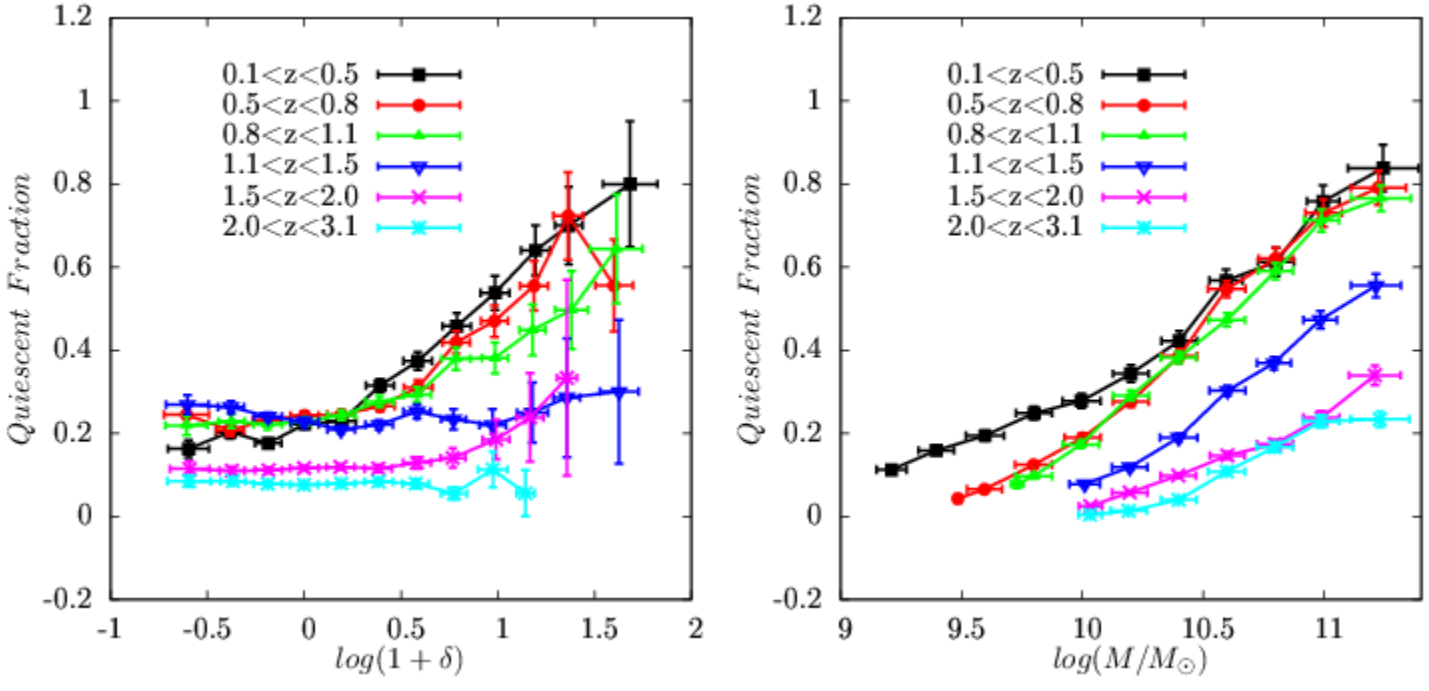
Quiescent Fraction



Quiescent fraction depends on the environment only at z<1. Quiescent fraction depends on stellar mass out to z ~ 3. Environmental quenching should happen on a short timescale at z<1.

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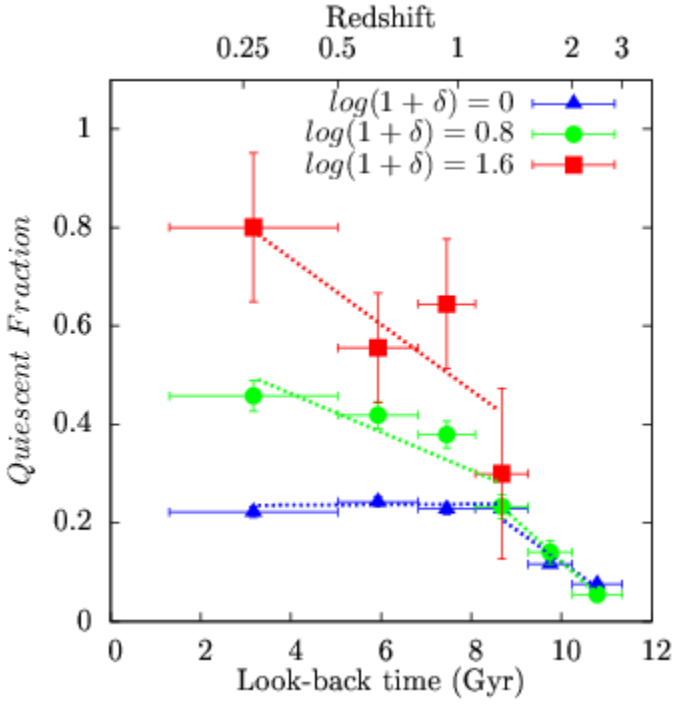
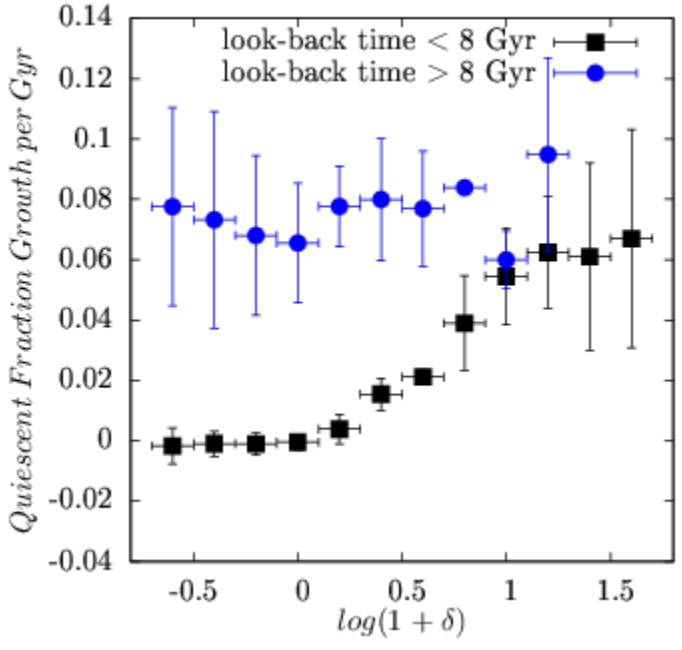
Quiescent Fraction growth rate





Growth rate is almost independent of environment at **look-back time > 8 Gyr . At look-bak time < 8 Gyr**, it increases with overdensity.

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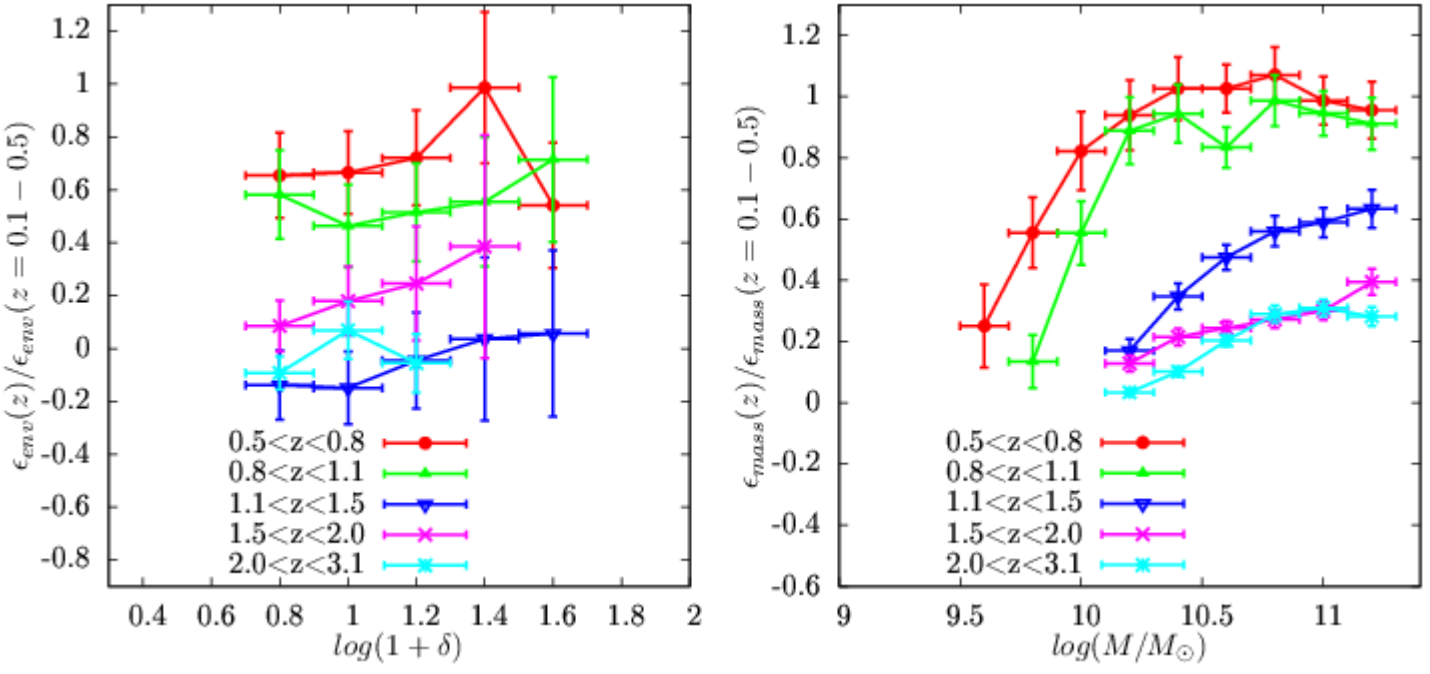
Environmental and mass quenching efficiencies



The overall environmental quenching efficiency increases with cosmic time.

For massive galaxies, the overall mass quenching efficiency increase from z ~ 3 to z ~ 1 and then it flattens out. For less massive galaxies, it continues to the present time.

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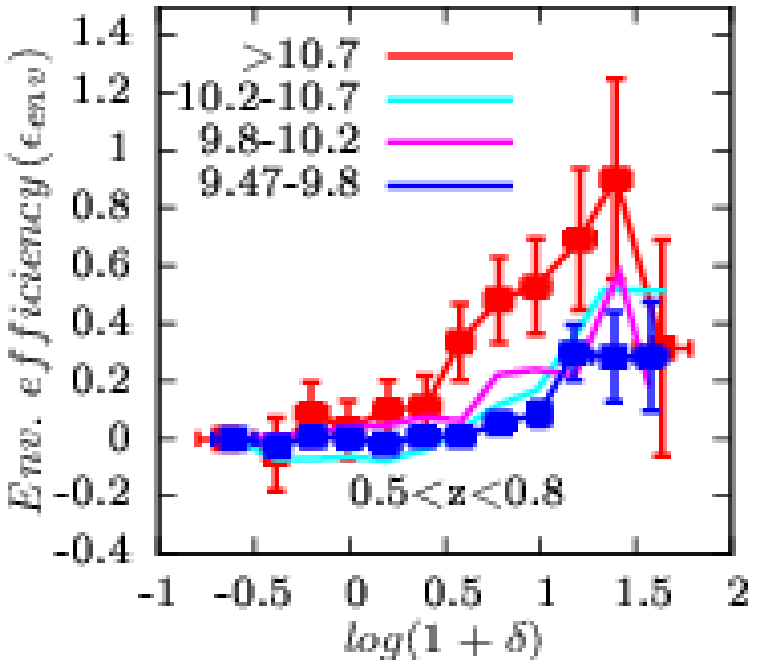
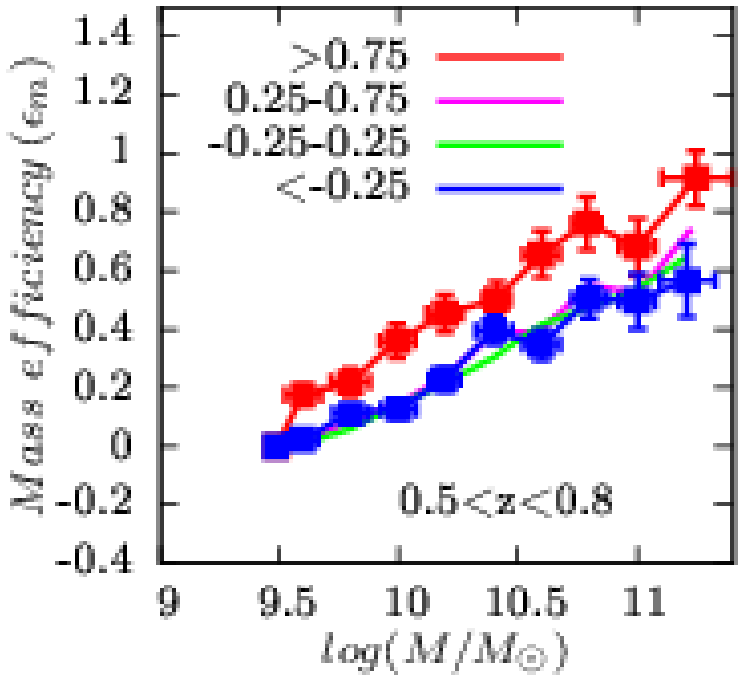
Environment and mass quenching efficiencies





Environment is more efficient in quenching more massive galaxies (mergers?)

Mass quenching is more efficient in denser environments. (non-AGN physics?)

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Summary & Conclusion

- Median **SFR and sSFR** (of all galaxies) strongly **depend** on environment at **z<1**. However, **for SF** galaxies, they are almost **independent** of environment. The **role of environment** is to **control the fraction** of SF/Q galaxies.

- **Fraction** of Q galaxies depends on **environment** only at **z<1**. **Fraction** of Q galaxies depends on **stellar mass** at **all the redshifts** considered.

- **At z<1**, galaxies are transferred from SF to Q population **more quickly** in **denser** environments.

- **Environment** is important in quenching SF activity **at z<1,** likely a **fast process**. At Higher z(**z>1**), **stellar mass** quenching is the dominant quenching mechanism.

- Environmental quenching efficiency increase with cosmic time. For massive systems, mass quenching efficiency increase from z ~ 3 to z ~ 1 and then flattens out.

- Denser environment are **more efficient** in quenching **more massive** galaxies, possibly due to a **higher merger rate?** in denser regions. Mass quenching is **more efficient** in **denser** environments, likely with a **non-AGN physics?** at z<1.