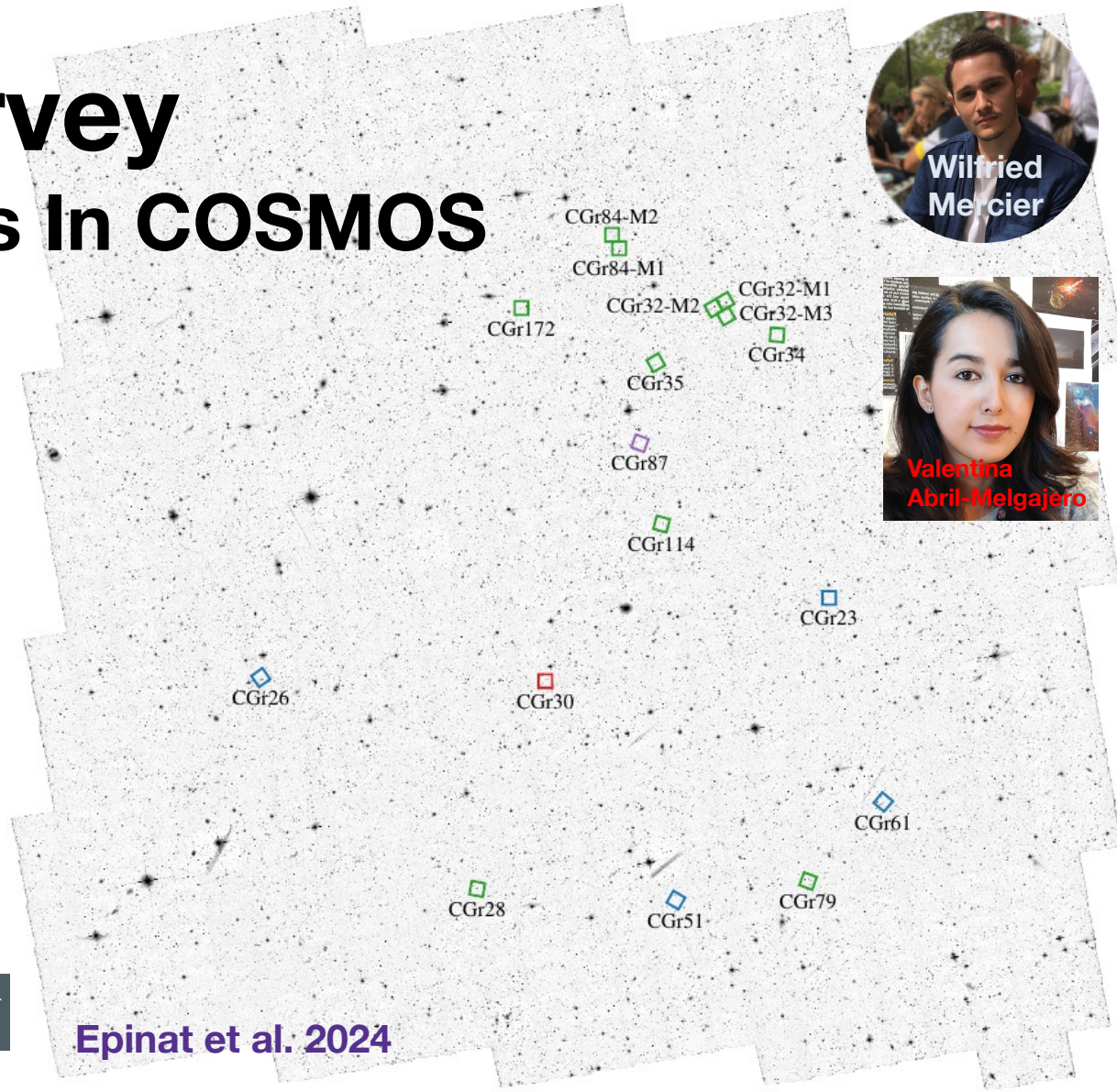


The MAGIC survey

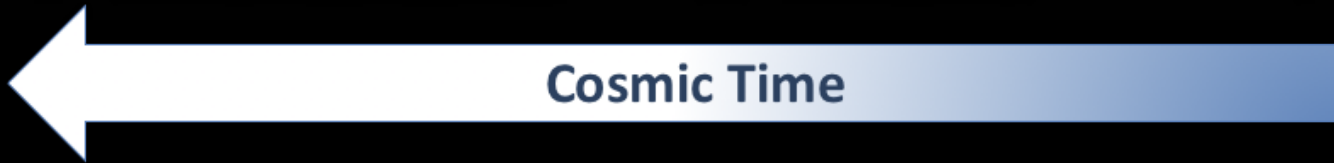
MUSE gAlaxy Groups In COSMOS

Benoît Epinat (CFHT/LAM), **Thierry Contini** (IRAP), **Wilfried Mercier** (LAM/IRAP), L. Ciesla, B. C. Lemaux, S. D. Johnson, J. Richard, J. Brinchmann, L. A. Boogaard, D. Carton, L. Michel-Dansac, R. Bacon, D. Krajnović, H. Finley, I. Schroetter, E. Ventou, **V. Abril Melgarejo** (STScI), A. Boselli, N. F. Bouché, W. Kollatschny, K. Kovač, M. Paalvast, G. Soucail, T. Urrutia, and P. M. Weilbacher

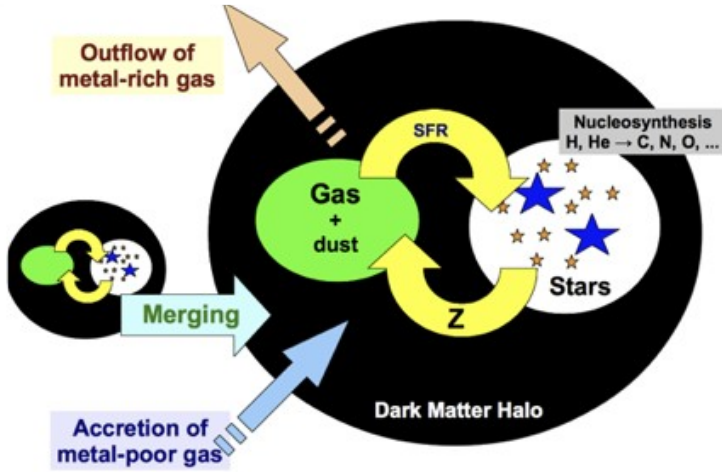


Epinat et al. 2024

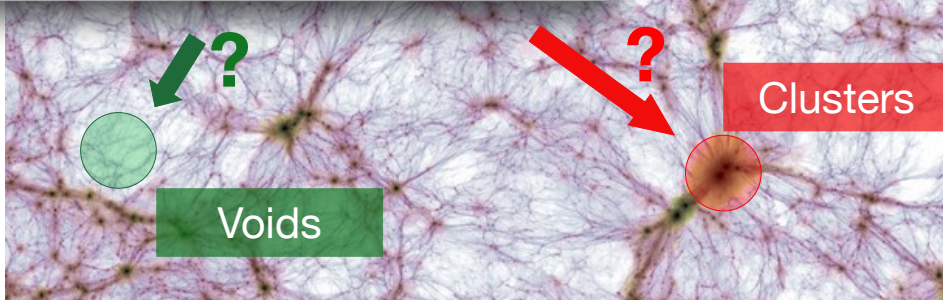
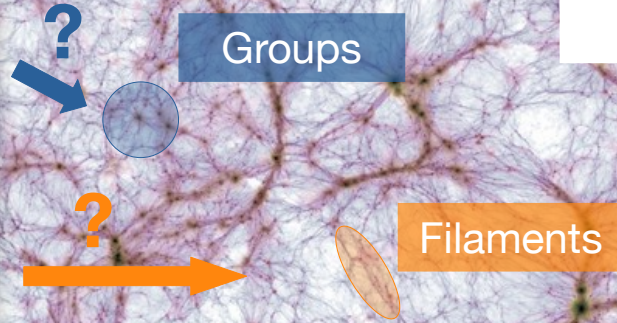
How did galaxies grow over time?



The (complex !) galactic ecosystem



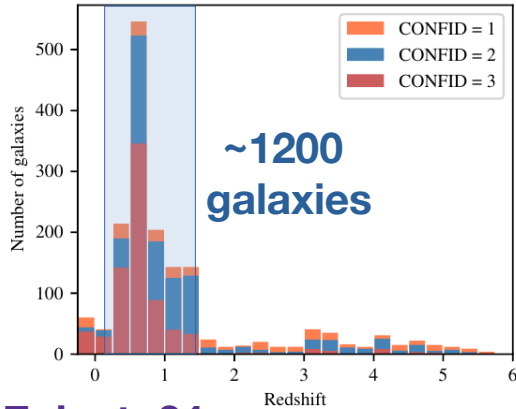
The **dark matter** skeleton of the universe is now quite **well reproduced** with simulations



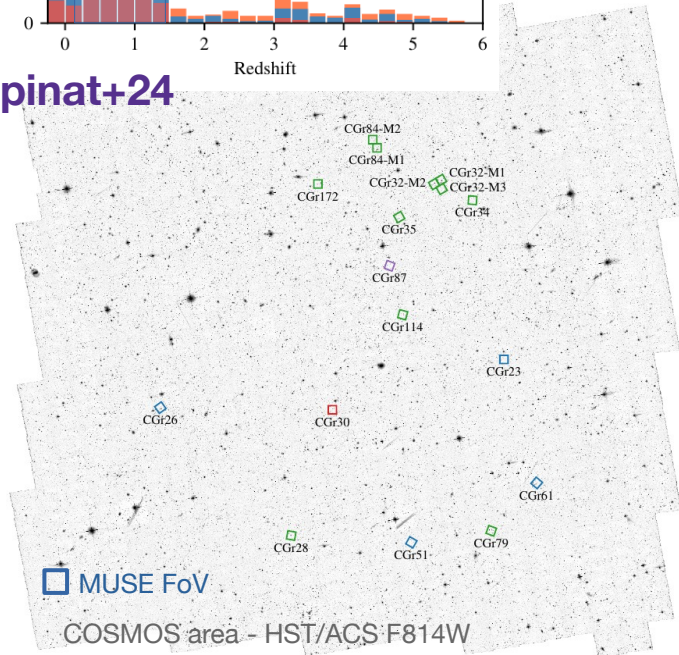
But how **baryons** cool down into DMH to **build galaxies** is still largely **unknown**

MAGIC in a nutshell

70h (on-source) **MUSE-GTO** survey



Epinat+24

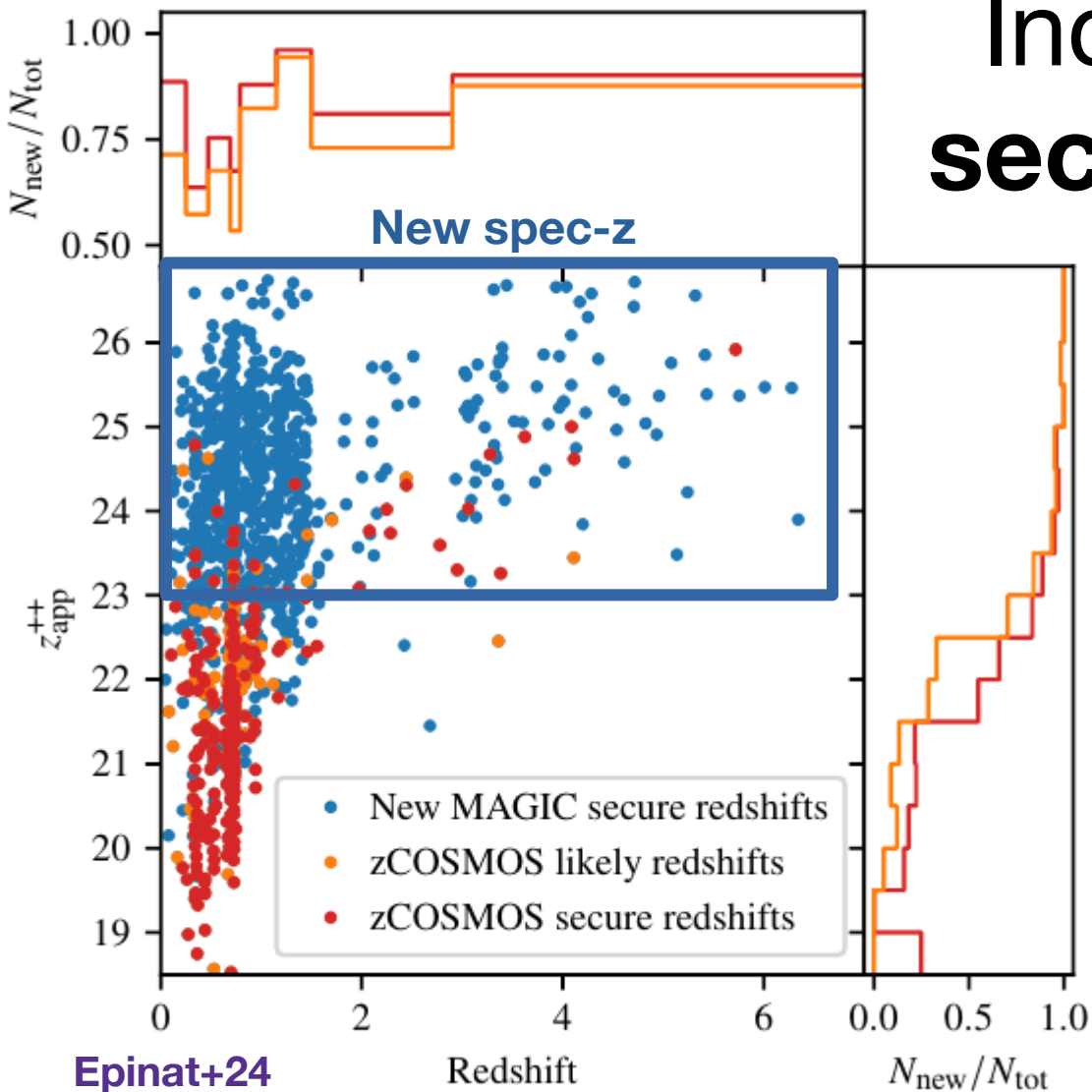


- **15 groups** pre-selected in **COSMOS** (Knobel+12)
- ~50% with adaptive optics → **FWHM ~ 0.5-0.6 arcsec**
- **$z \sim 0.5 - 1.5$** = sweet spot to probe the **impact of environment**
- **SED-fitting** with Cigale using 20+ photometric bands including HST/ACS (thanks to Laure Ciesla !!)

*A survey to probe the **impact of environment** on galaxy evolution over the last 8 Gyr*

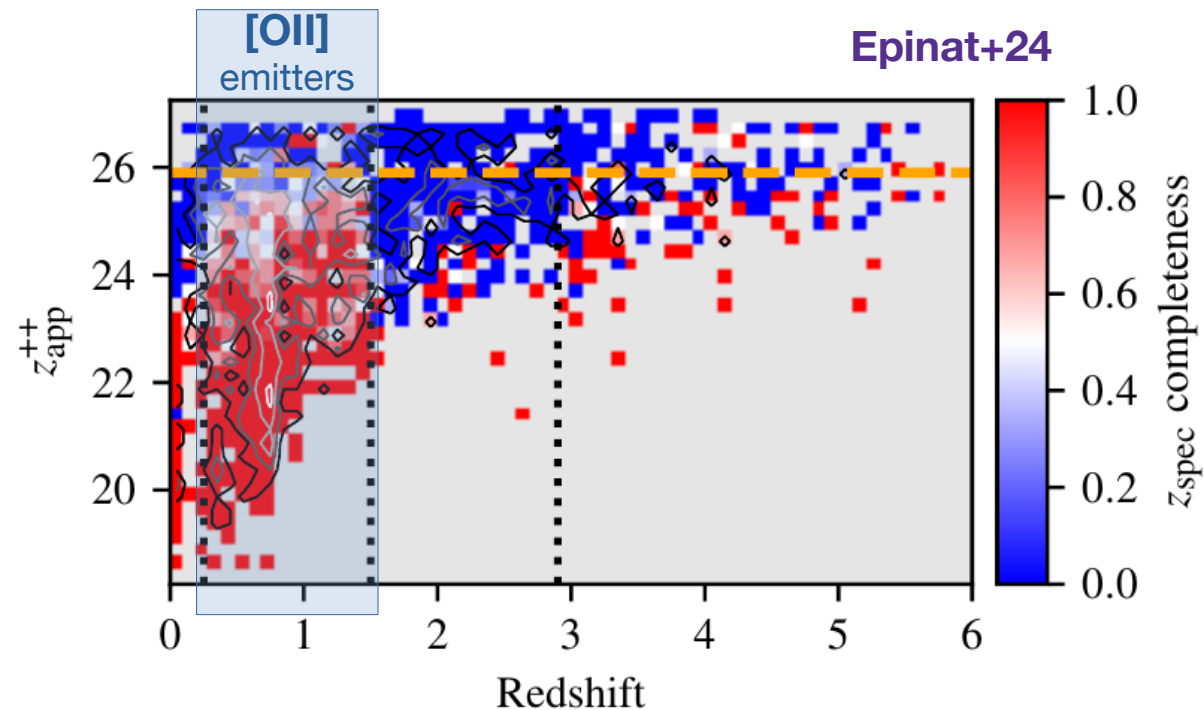
- **Kinematics & Scaling relations**
 - MS, size-mass, TFR (Abril-Melgajero+21, Mercier+22)
 - Angular momentum, “Fall” relation (Mercier+23)
- **Giant ionized gas structure** in dense group (Epinat+18)
- First evidence for **ram pressure stripping** @ $z \sim 0.7$ (Boselli+19)

Increasing density of secure spectroscopic redshifts



- 1414 secure spec-z
- Increase by a factor of 5
- Faint galaxies with $z_{\text{app}}^{++} > 23$ not well sampled previously

Spectroscopic redshifts **completeness**



At $0.25 < z < 1.5$ ([OII] emitters)

- Completeness **> 80%** for $z^{++} < 26$
- Locally **>90%** for $M_* > 10^{10} M_{\odot}$
- Locally **>70%** for $M_* > 10^9 M_{\odot}$
- Locally **>60%** for $M_* > 10^8 M_{\odot}$

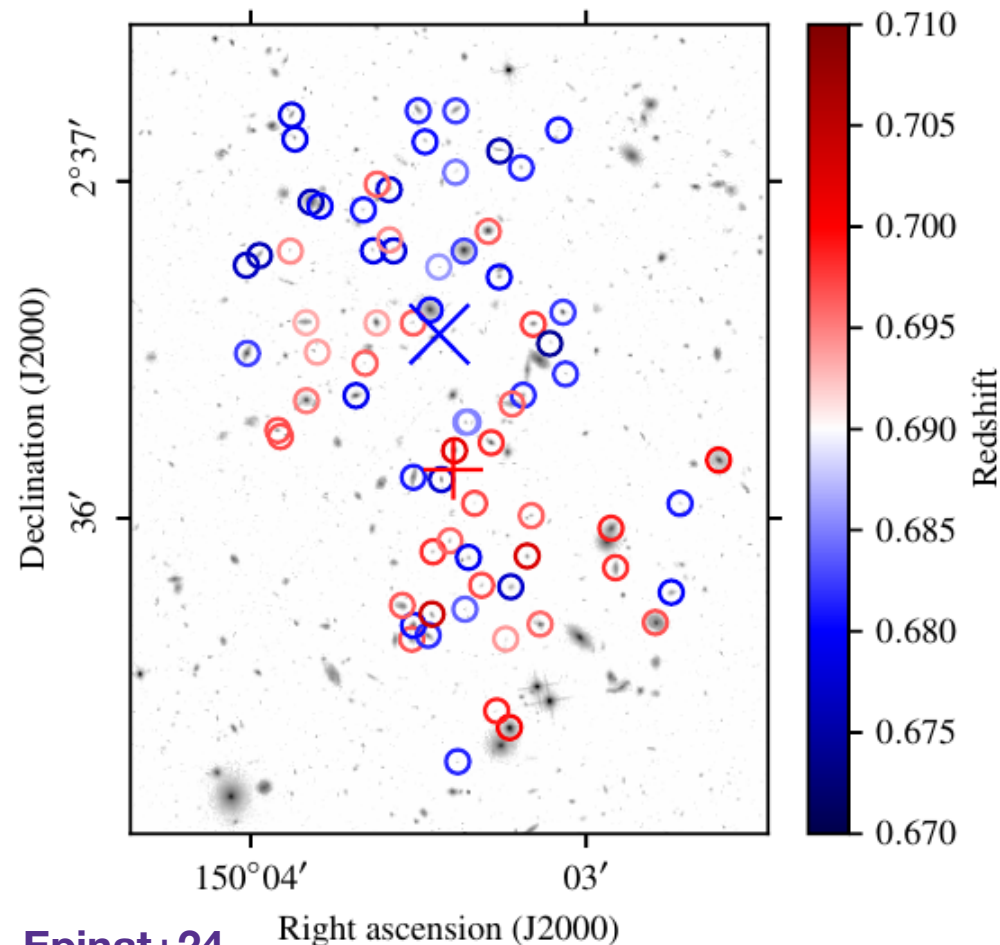
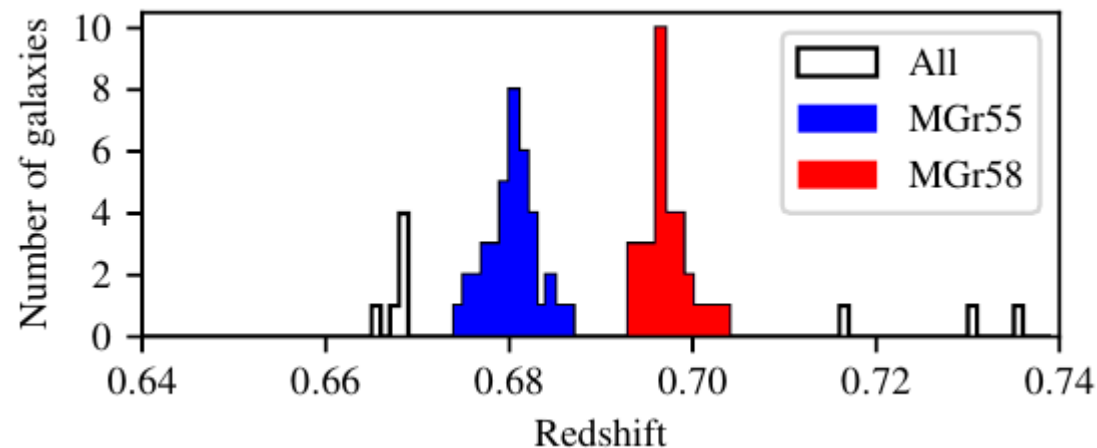
Excellent completeness achieved for faint and low-mass galaxies

Friends-of-friends group finding algorithm

Constraints on both:

- Angular separation
→ $\Delta r < 375 - 225$ kpc
- Redshift separation
→ $\Delta v < 500 - 300$ km/s

Limits depend on group richness



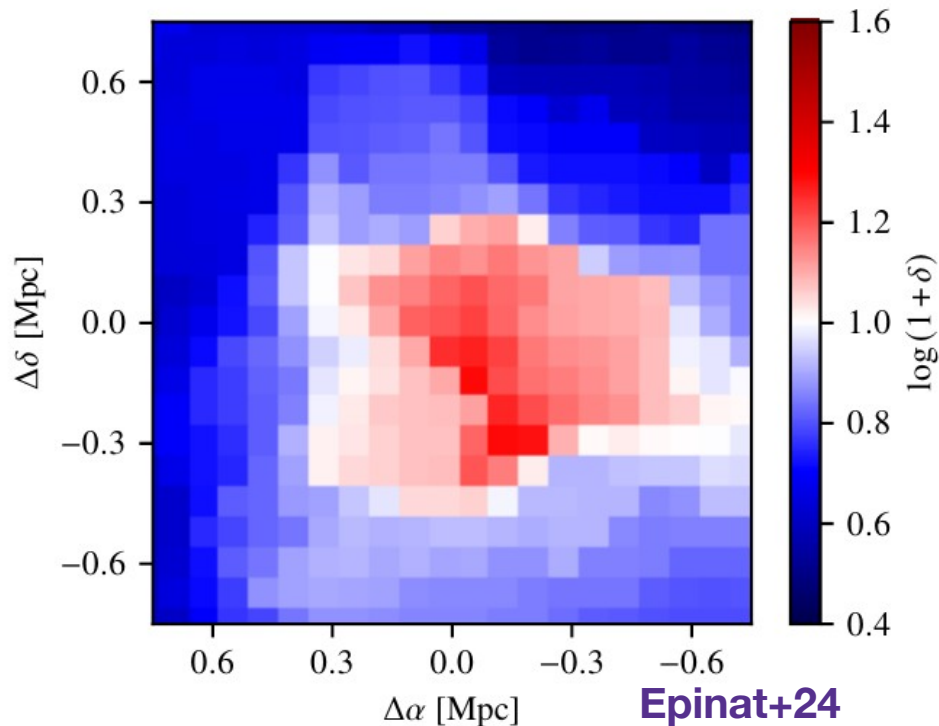
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Local environment estimates

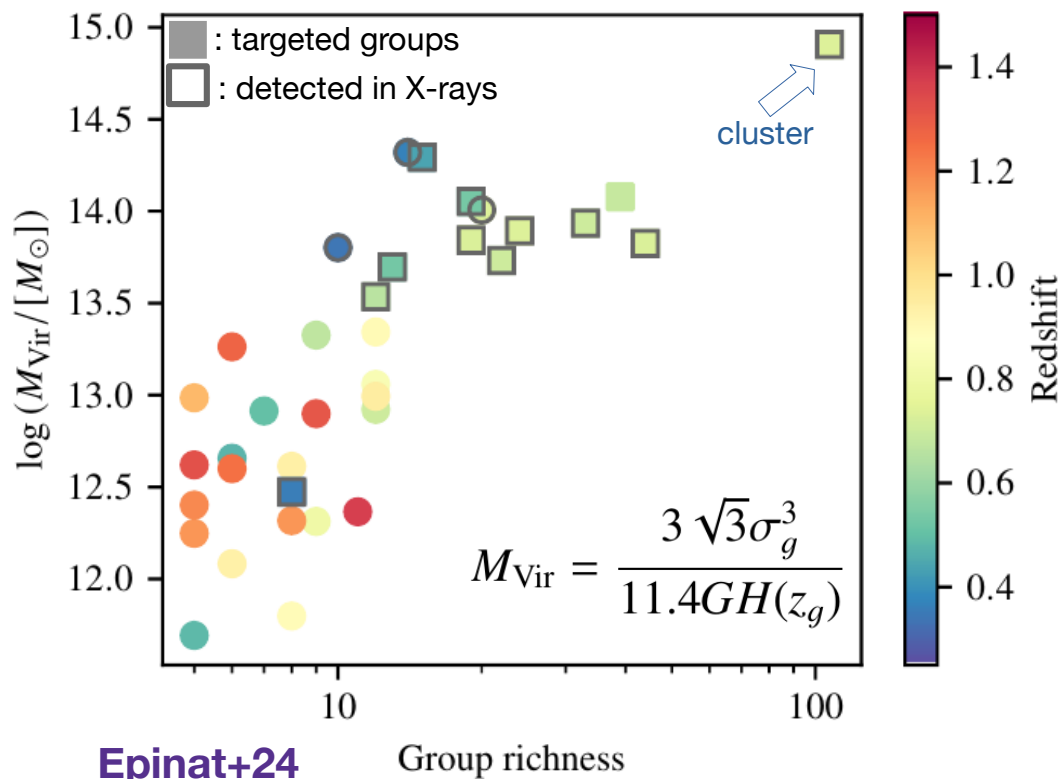
- Homogeneous sampling
- zCOSMOS spec-z compilation
- COSMOS photo-z + uncertainties
- 75x75 kpc pixels
- ± 3.75 Mpc slices

Overdensity parameter ($1 + \delta$) =
Local density / Median density in
the slice

Voronoi Monte Carlo (VMC, Lemaux+22)



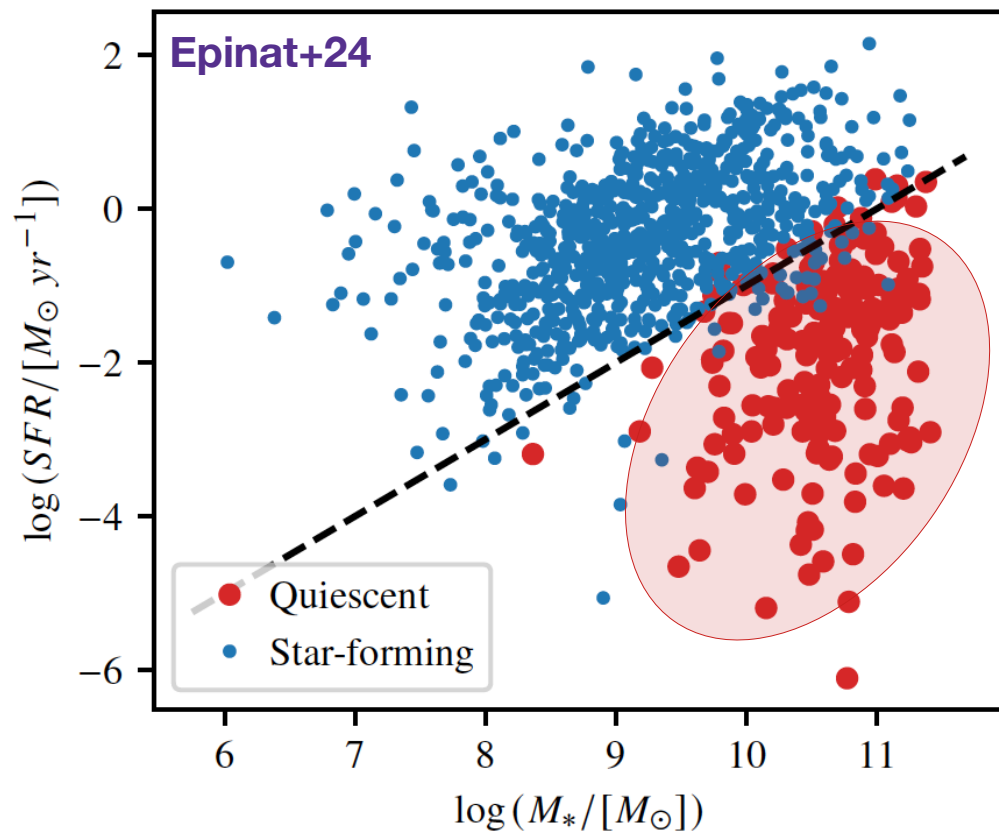
Targeting groups and fishing others



- **66 groups**, including 19 with 10+ members
- **1 cluster**
- Most groups are at **$z \sim 0.6 - 1$**
- Good correlation between mass and richness
- Targeted groups are among the most massive ones (also detected in X-rays)

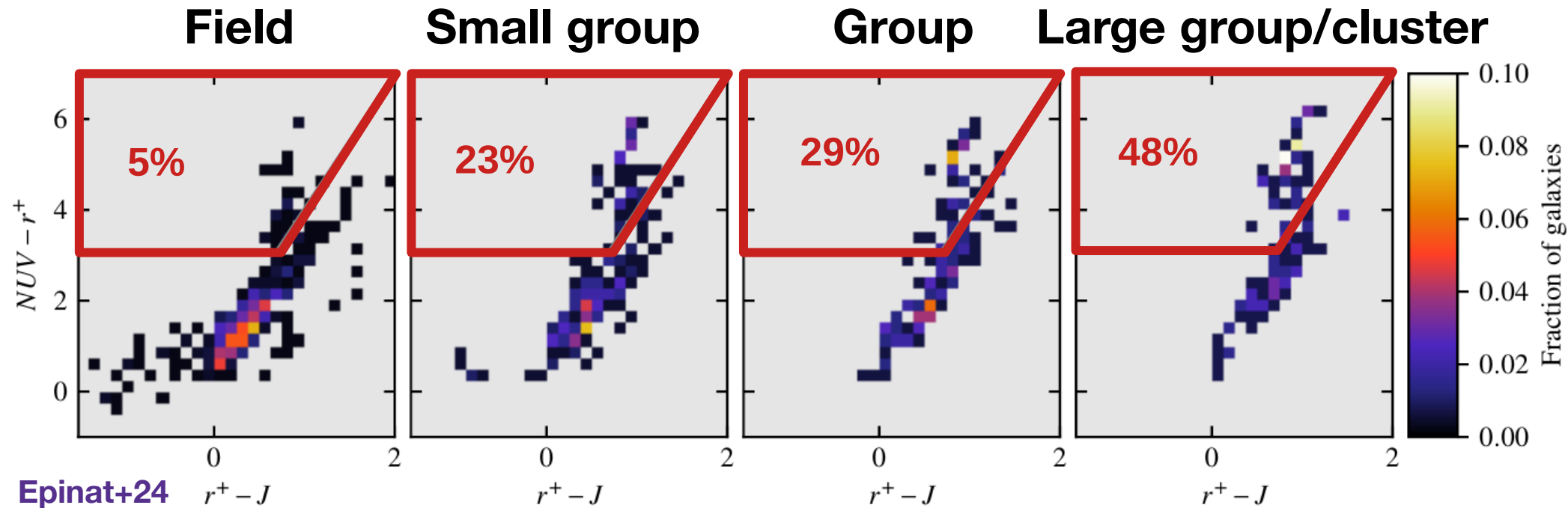
→ **very good galaxy statistics for various environments/richness**

Environment-induced red sequence



Environment-induced **red sequence**

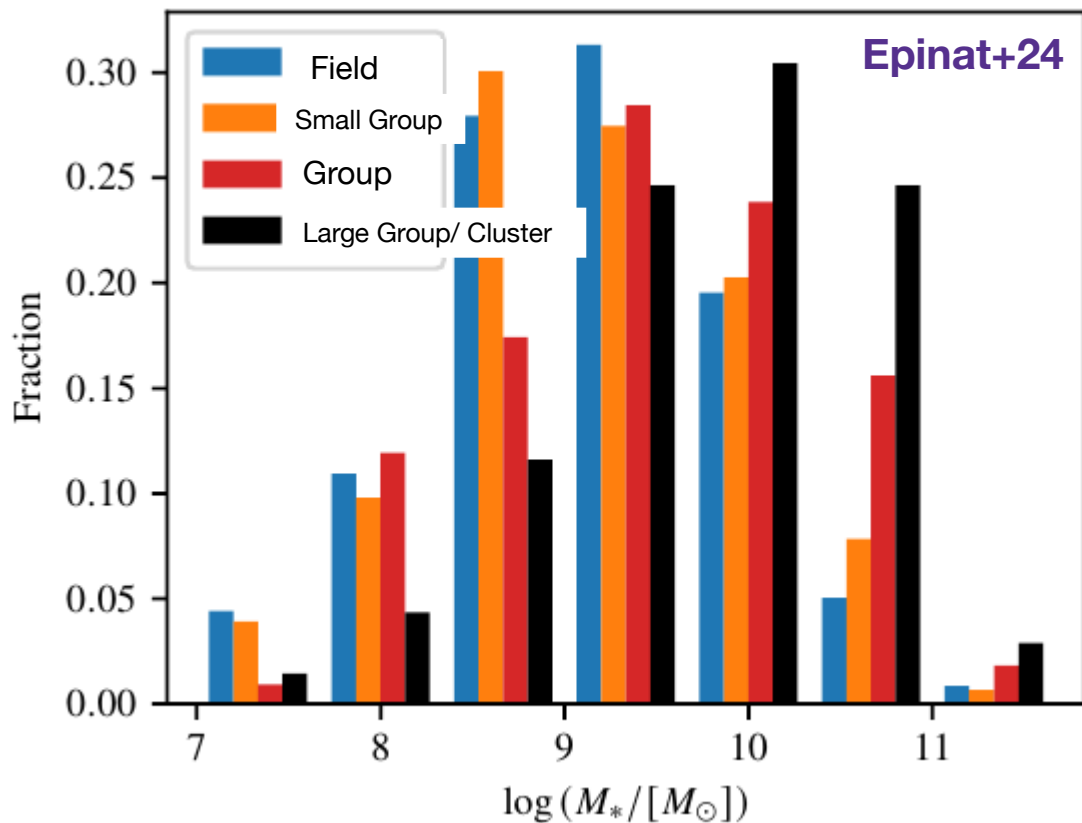
Red sequence defined using rest-frame color-color diagram \rightarrow colors inferred from SED fitting with CIGALE



Red fraction increases with group mass, richness, and local density

Galaxy properties vs. environment

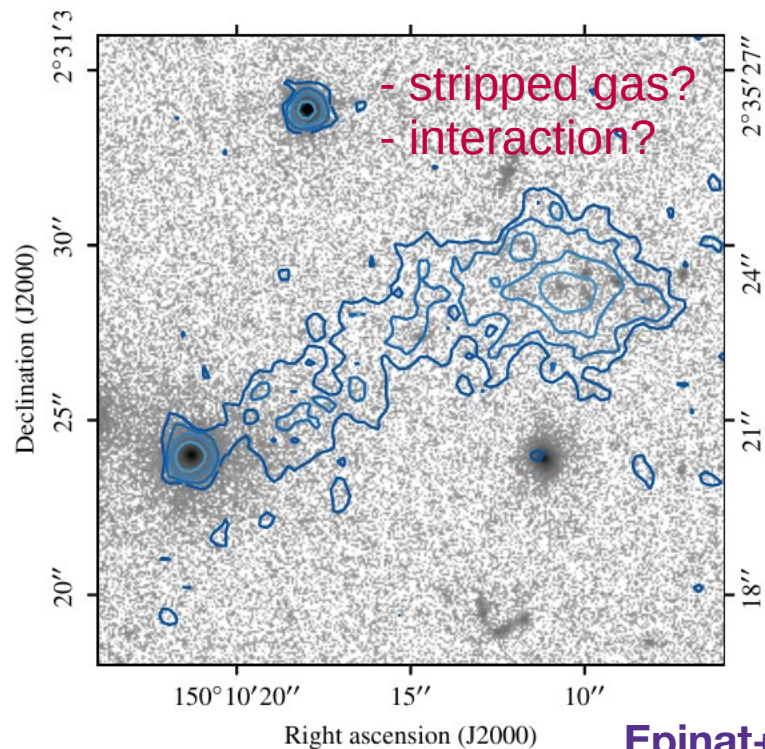
Red sequence **excluded**



- Fraction of massive galaxies increases with density
 - Few low-mass galaxies in the densest environments
- Small galaxies merged to higher mass galaxies as density increases
- **Pre-processing in groups of increasing mass**

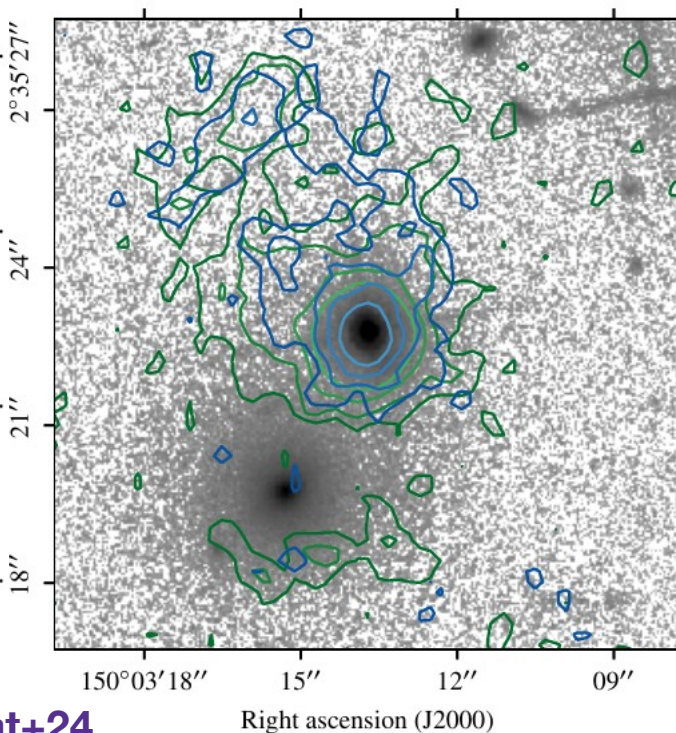
Unexpected features in MAGIC !

**Extended ionized gas
nebula in CGr172 at $z \sim 0.7$**

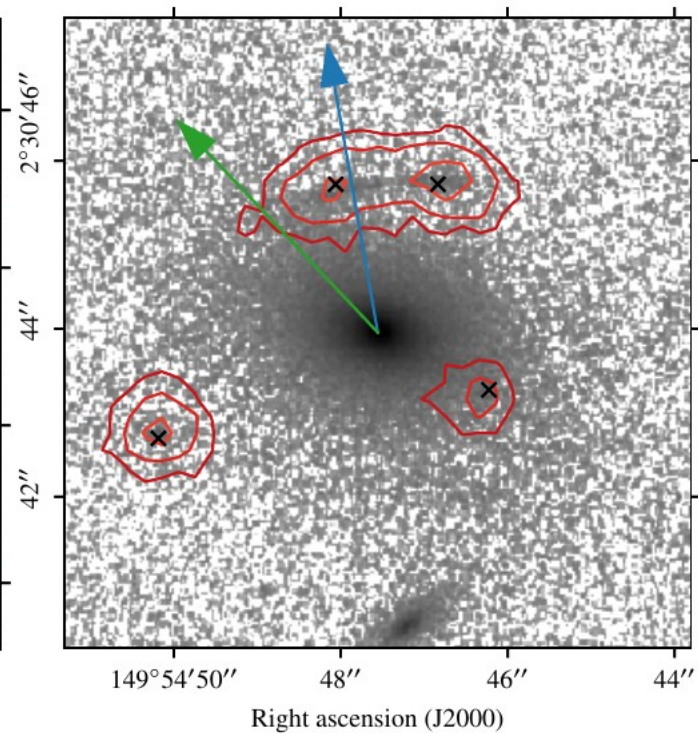


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**Extended [OII] and [OIII]
ionized gas nebula around
 $z \sim 0.7$ QSO in CGr84**



**Gravitational arc at $z \sim 4$
around massive lensing
galaxy in CGr32**



Conclusions & Prospects

- **MAGIC is a very rich dataset !**
- **Release of group and galaxy catalogs**, with environment information (Epinat+24)
<https://vizier.cds.unistra.fr/viz-bin/VizieR-3?-source=J/A%2bA/683/A205/galaxy>
- **Reduced datacubes @ ESO**
<https://archive.eso.org/cms/eso-archive-news/release-of-muse-galaxy-groups-in-cosmos-magic-survey-datacubes.html>
- Access to **low-mass galaxies** with **high spec-z completeness**
- **Diversity** of environments
- **Red sequence continuously growing** when environment gets dense + when reaching the central regions of massive groups
- Low-mass galaxies less present in massive groups
→ **pre-processing in small groups**

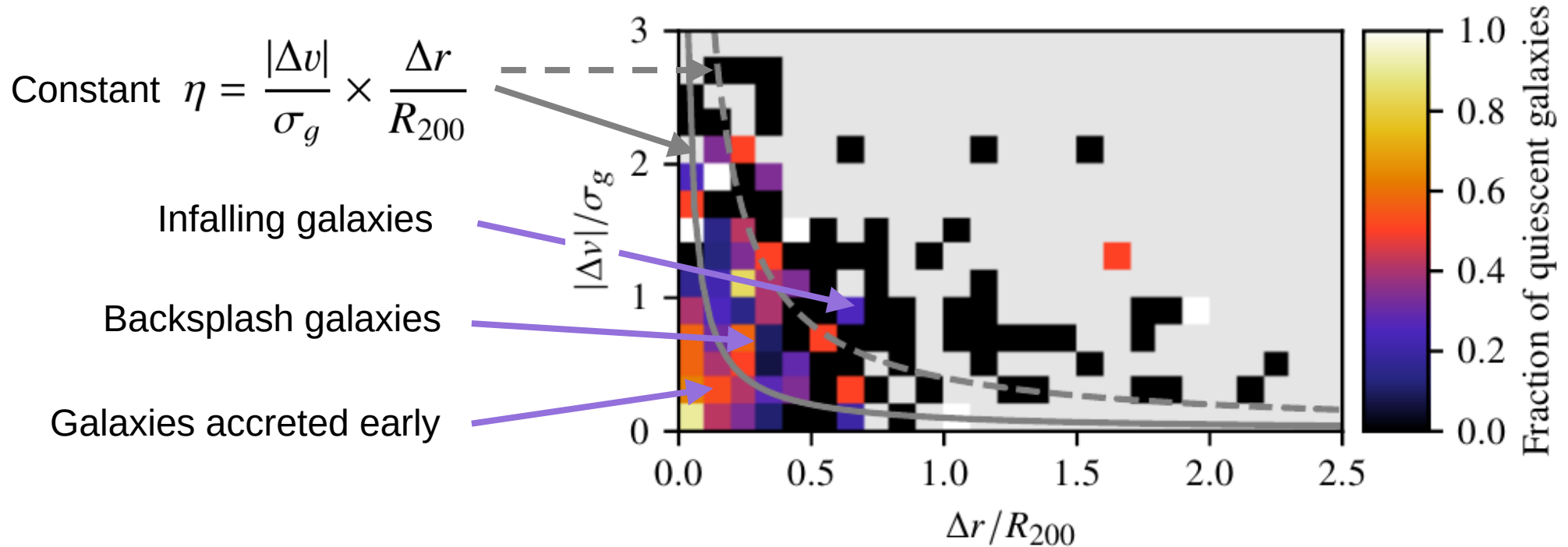
Next steps: **larger field-of-views to map cosmic web at intermediate redshift**

- short-term: combine with other GTO/archives fields (MUSE-Wide, HUDF, **MUSCATEL**, ...)
- mid/long-term: MOONS, **WST** (IFU+MOS)

Additional slides

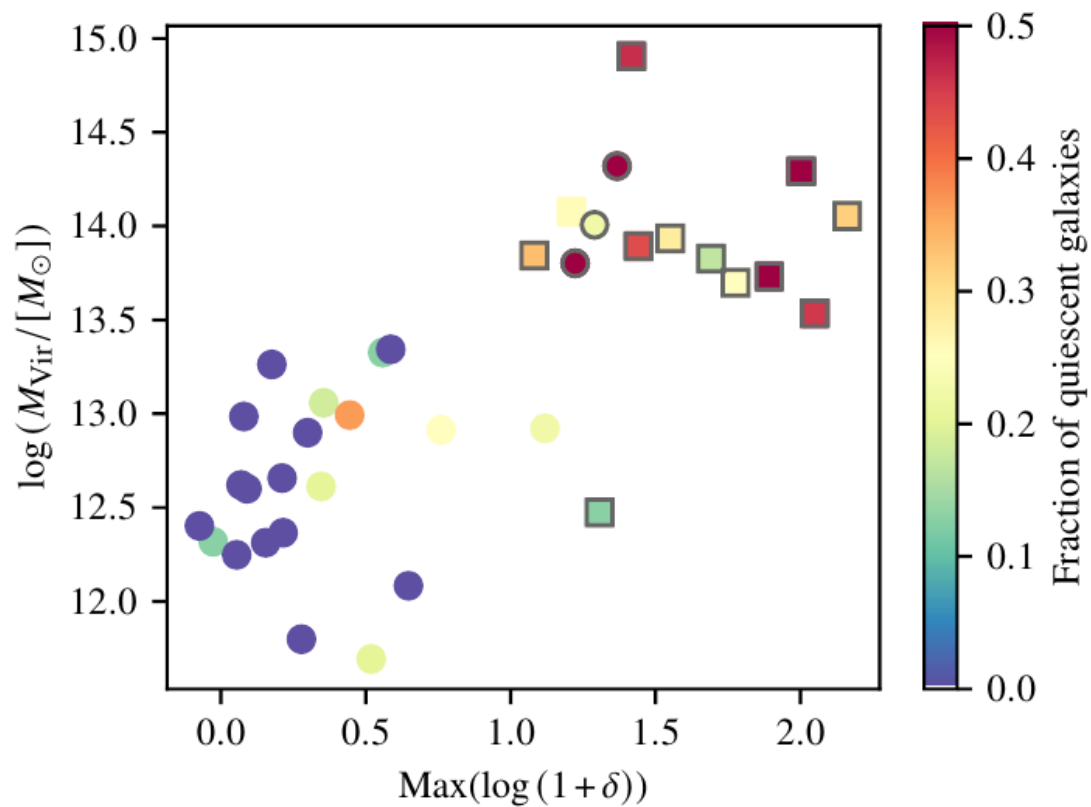
Red sequence

Phase-space diagram: location within well defined groups (at least 5 galaxies)
→ global environment, time spent in groups



Red fraction also increases with time spent in structures

Group properties



Global environment estimates

Where are located galaxies within well defined groups?

$$\eta = \frac{|\Delta v|}{\sigma_g} \times \frac{\Delta r}{R_{200}}$$

$$M_{\text{vir}} = \frac{3 \sqrt{3} \sigma_g^3}{11.4 G H(z_g)}$$

$$R_{200} = \frac{\sqrt{3} \sigma_g}{10 H(z_g)}$$

Tells us when galaxies entered groups