LoCuSS: Pre-processing in galaxy groups falling in to massive galaxy clusters at z=0.2

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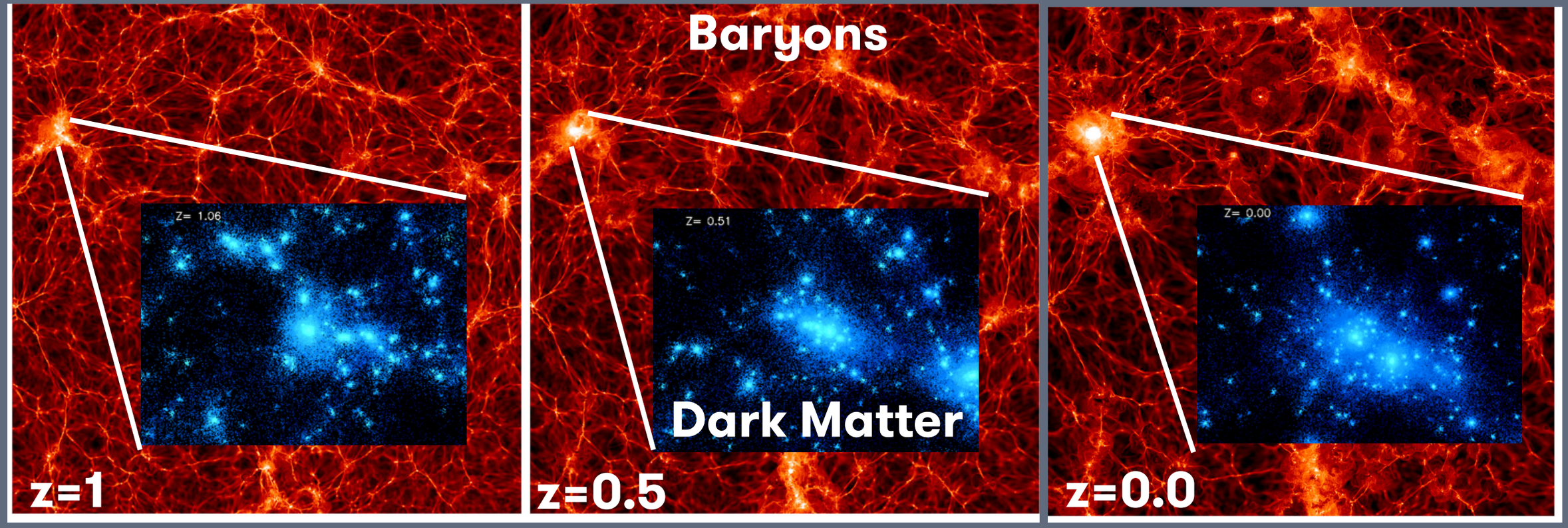
Outline

- Cluster formation and pre-processing
- LoCuSS: infalling group sample
- Results
- Future prospects

Cluster formation

- Clusters appear last in the structure formation ladder
- Doubled in mass since z =0.5 (Gao+ 2012)
- 1/2 Galaxies accreted below z=0.4 (Berrier+ 09)
- Groups contribute to 50% and 45% of a cluster stellar mass and galaxy population, respectively (McGee+ 09)

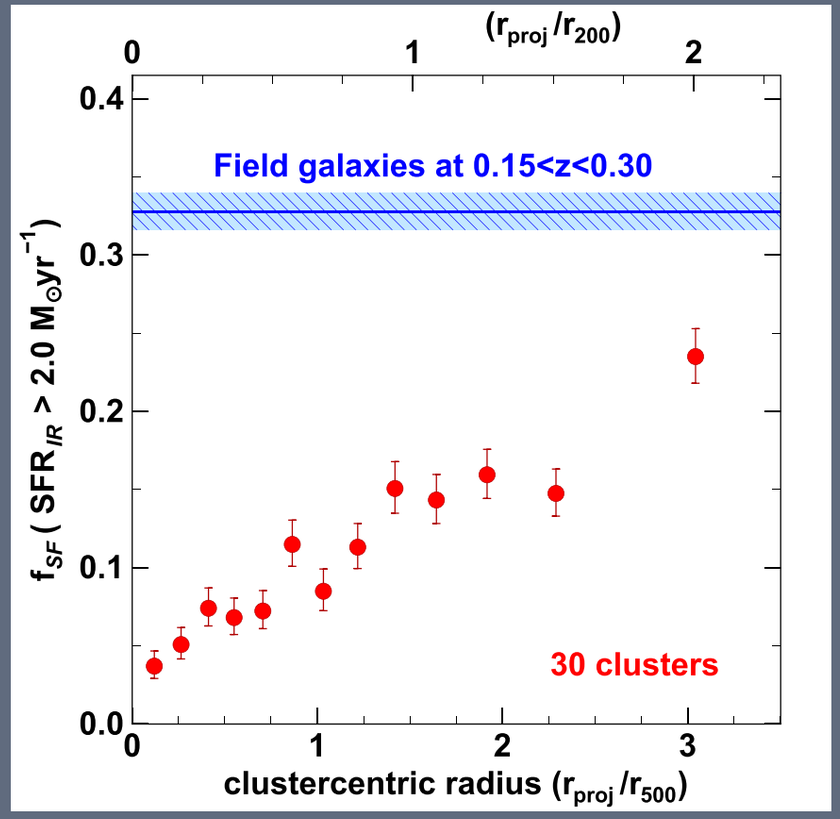


Illustris simulation, Haider+ 16

Star formation quenching

- SF quenching is acting on infalling galaxies already prior to them settling in the cluster potential (Fujita 04)
- Deficit of SF galaxies up to 5 r_{200} (Bahè+ 13, Wetzel+13)
- SF quenching due to harassment and starvation (Larson+ 80, De Lucia+12, Peng +15)

Haines+ 15



Effective combination of high number density and low relative velocity between galaxies

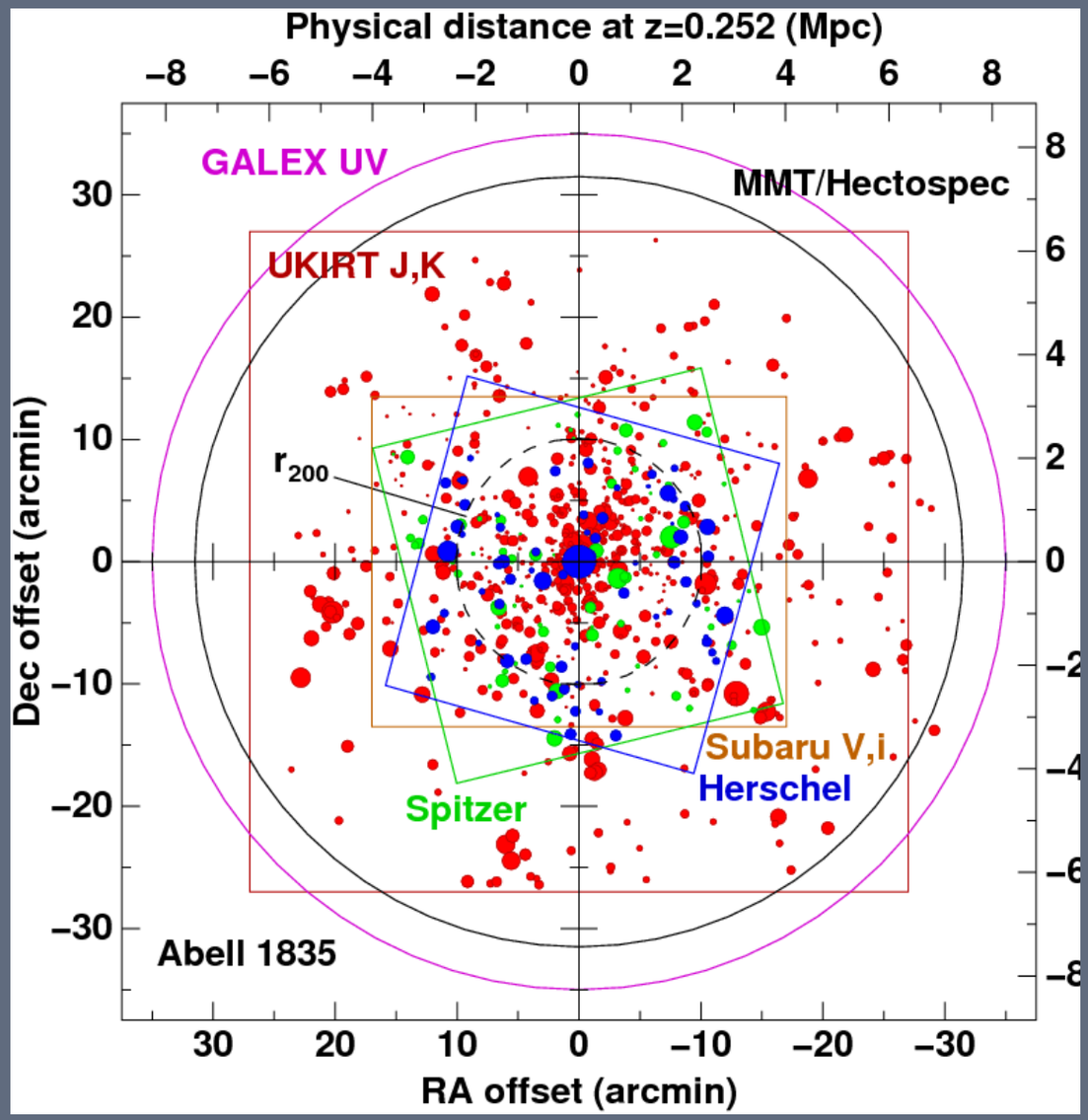
Group as favourable locus for pre-processing?

LoCuSS survey

- Multi-wavelength survey of X-ray luminous clusters at 0.15<z<0.30
- Data cover the central 25'x25' cluster region

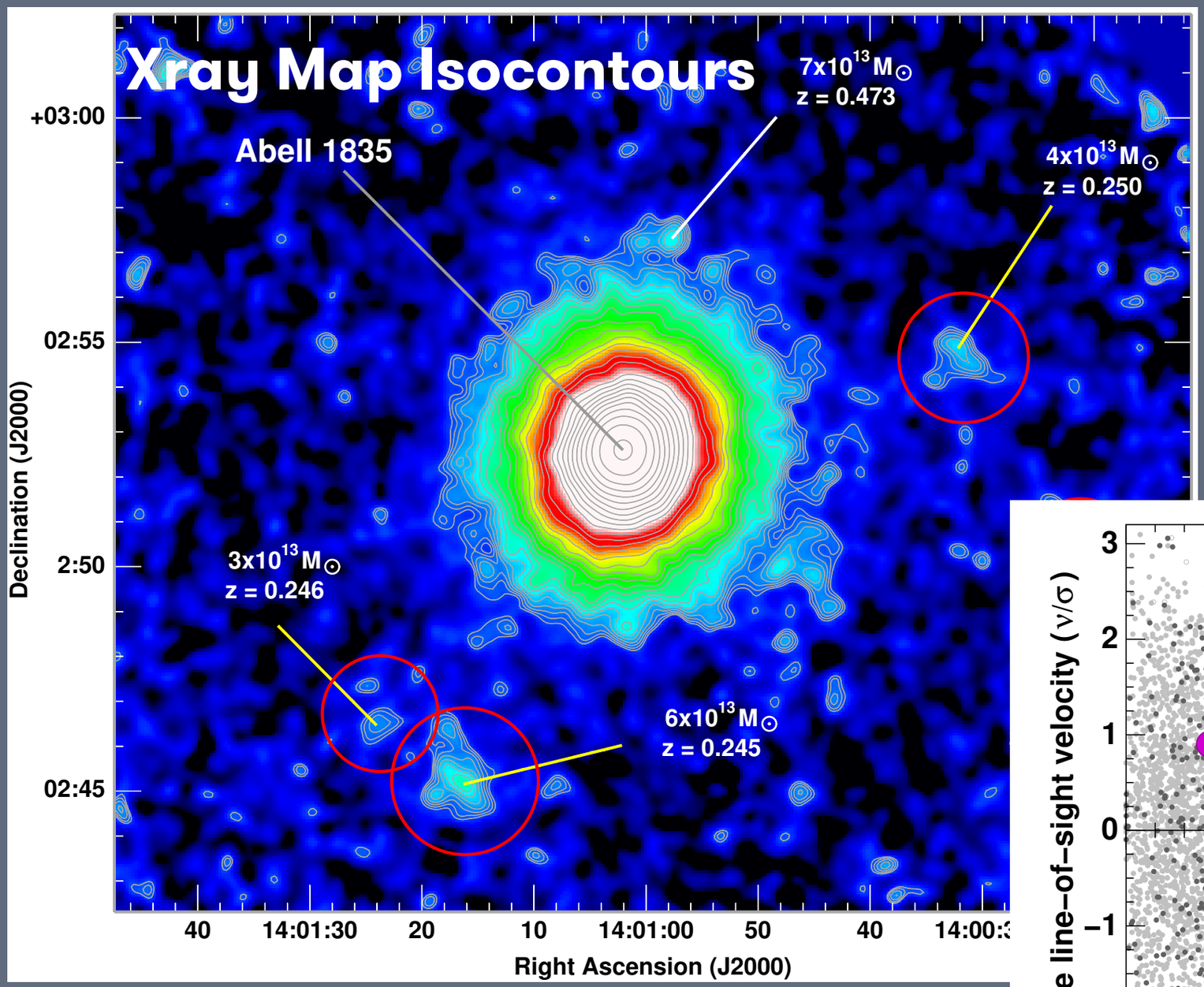
- J-K color selection for spectroscopic targets down to $m_{K^*}(z_{cl}) + 1.5$ —> $M_* \approx 2 \times 10^{10}\, M_\odot$
  - weak dependence on SFR and SFH
  - no morphological bias

- 96% spect. completeness for MIPS 24 μm sources
- 90% phot. completeness at 400μJy

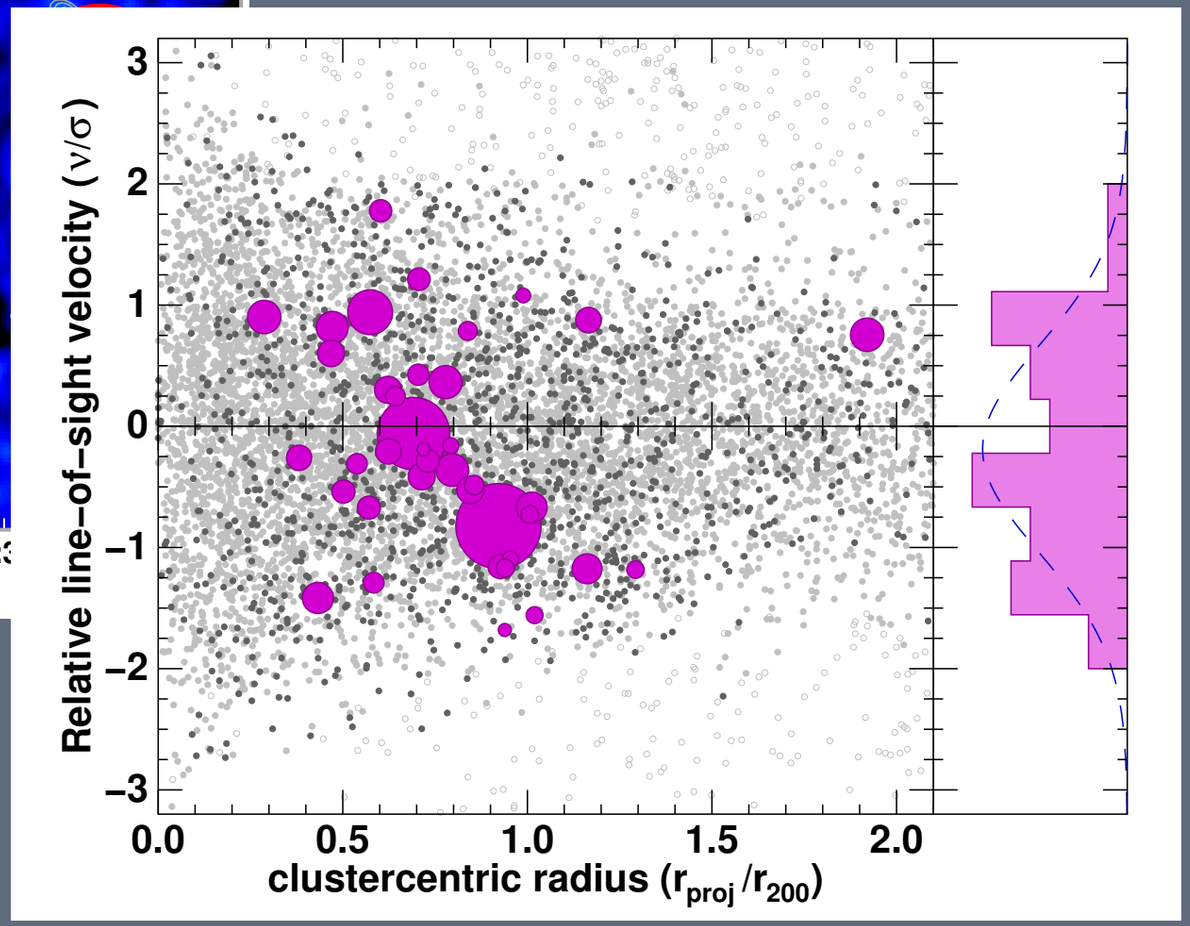


Courtesy of E. Egami

Group identification

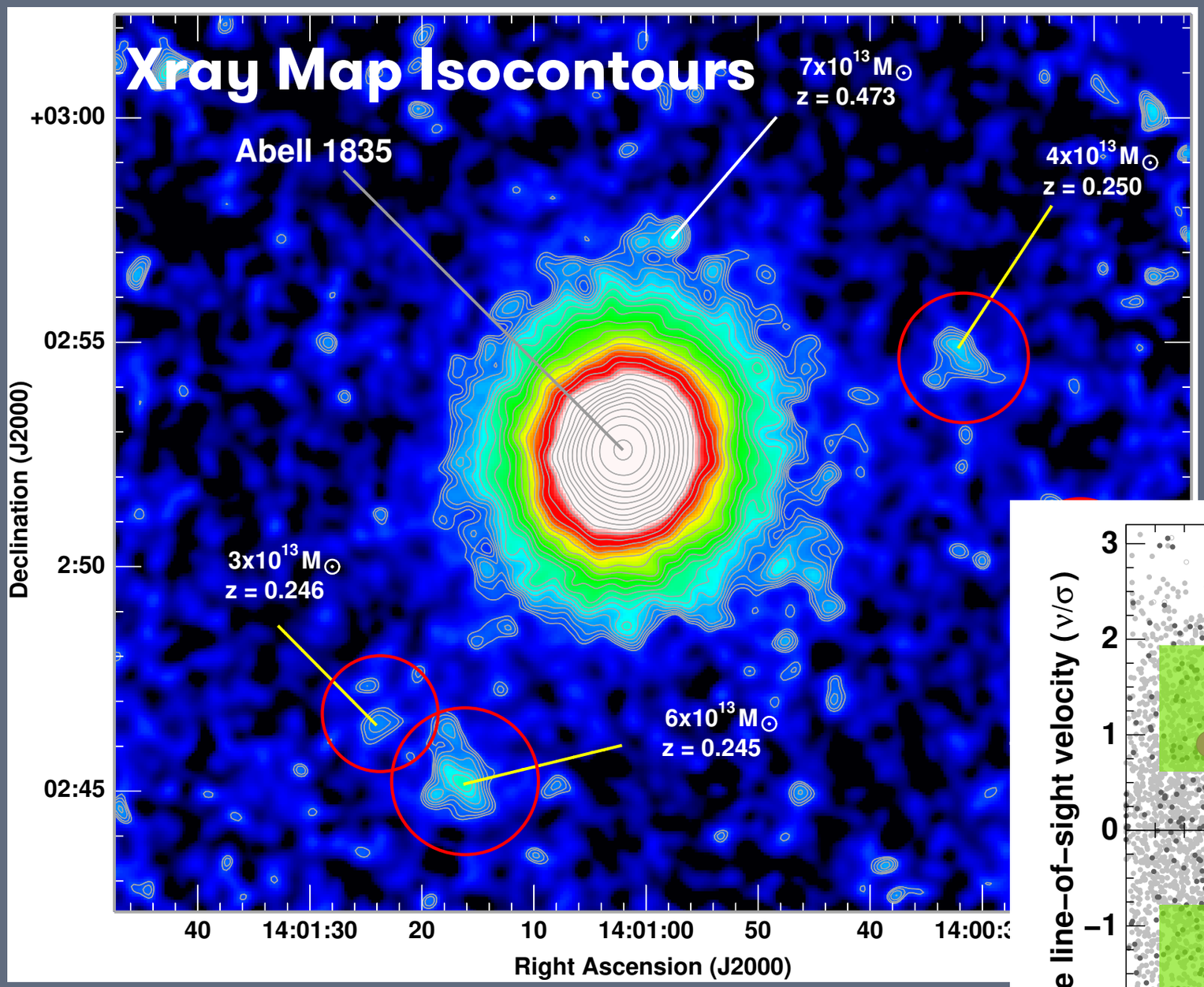


- 4σ IGM Xray detection threshold
- 97 groups with z < 0.7
- Every group with z< 0.3 has a spect. member



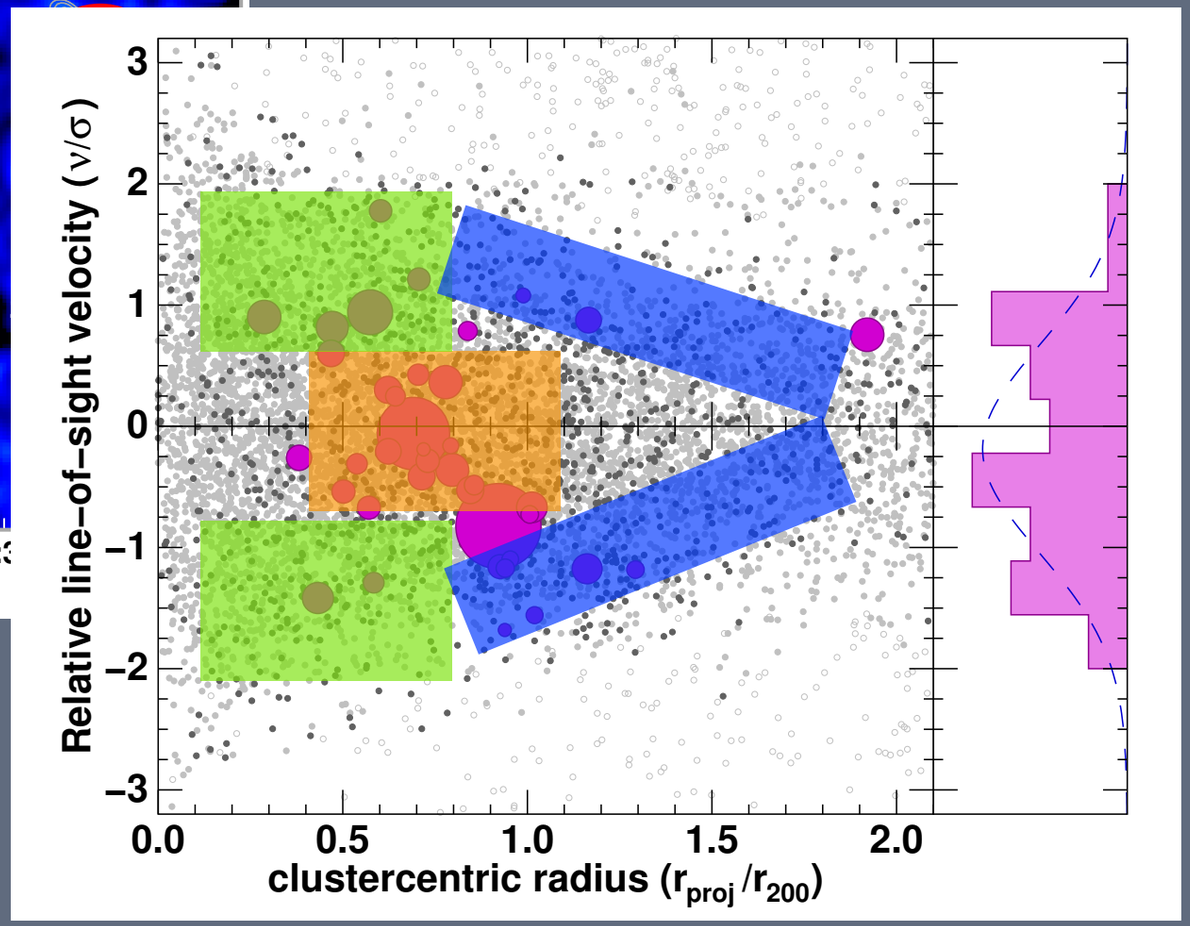
Haines+ 17

Group identification



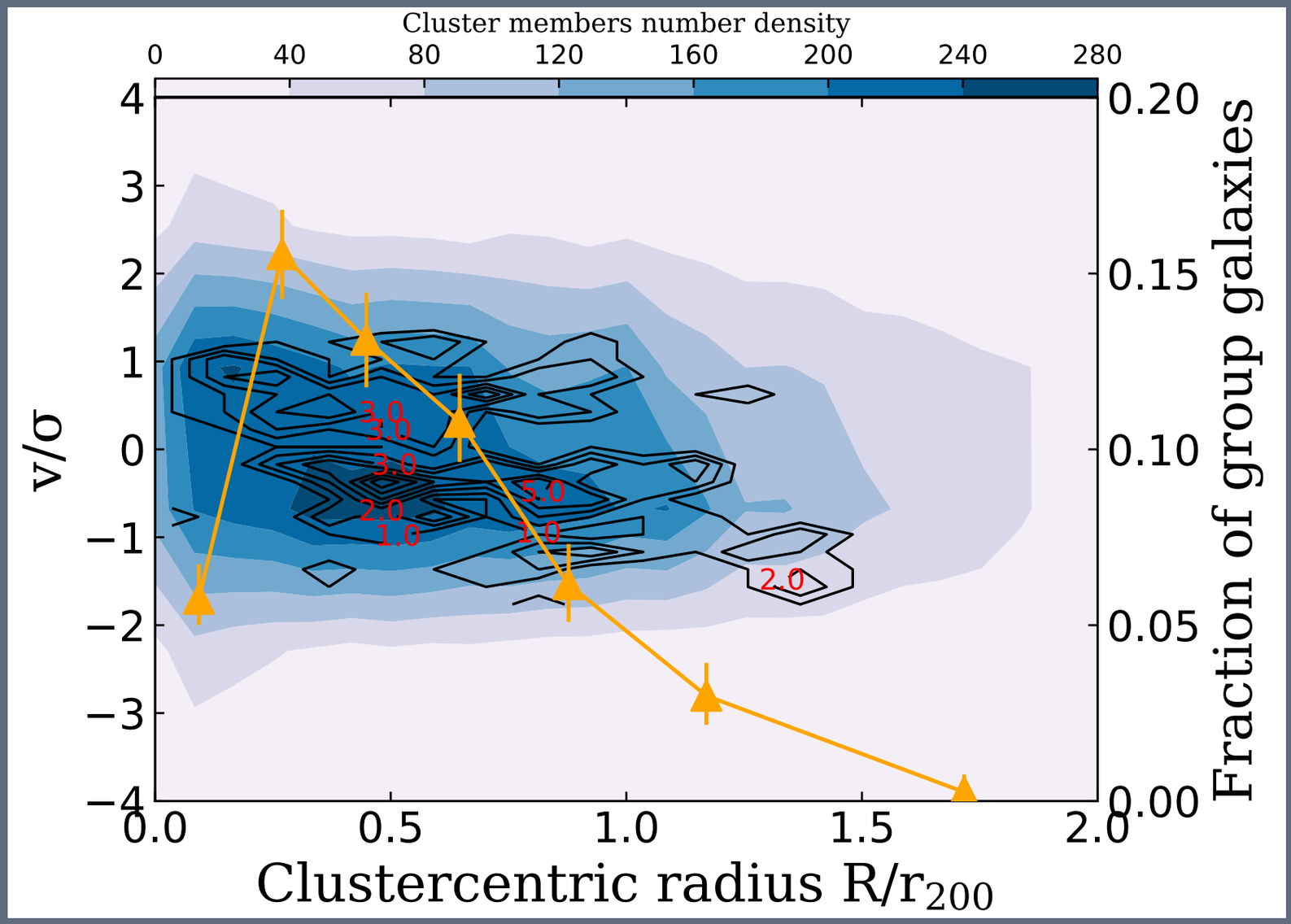
Haines+ 17

New/Intermediate/ recent infallers (Haines+15, Rhee+17)



Group member selection

- 34 groups with 0.15<z<0.3 (subsample of Haines+ 17)
- from L_x —> $M_{200} \approx 5 \times 10^{13}\ M_\odot$, $r_{200} \approx 800$ kpc



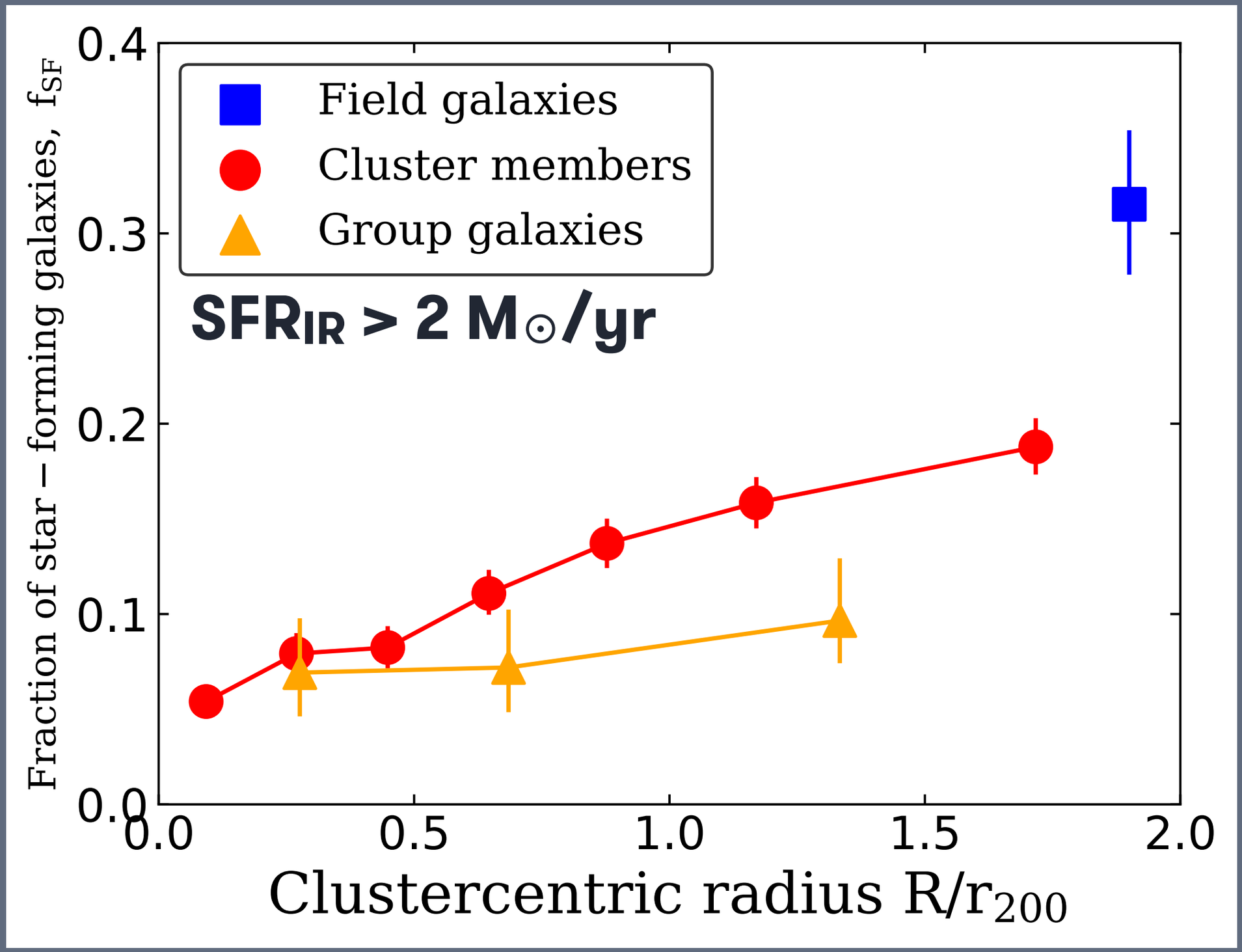
MB+ 17

Member if:

- $D < r_{200}$
- $|v| < 500$ km/s

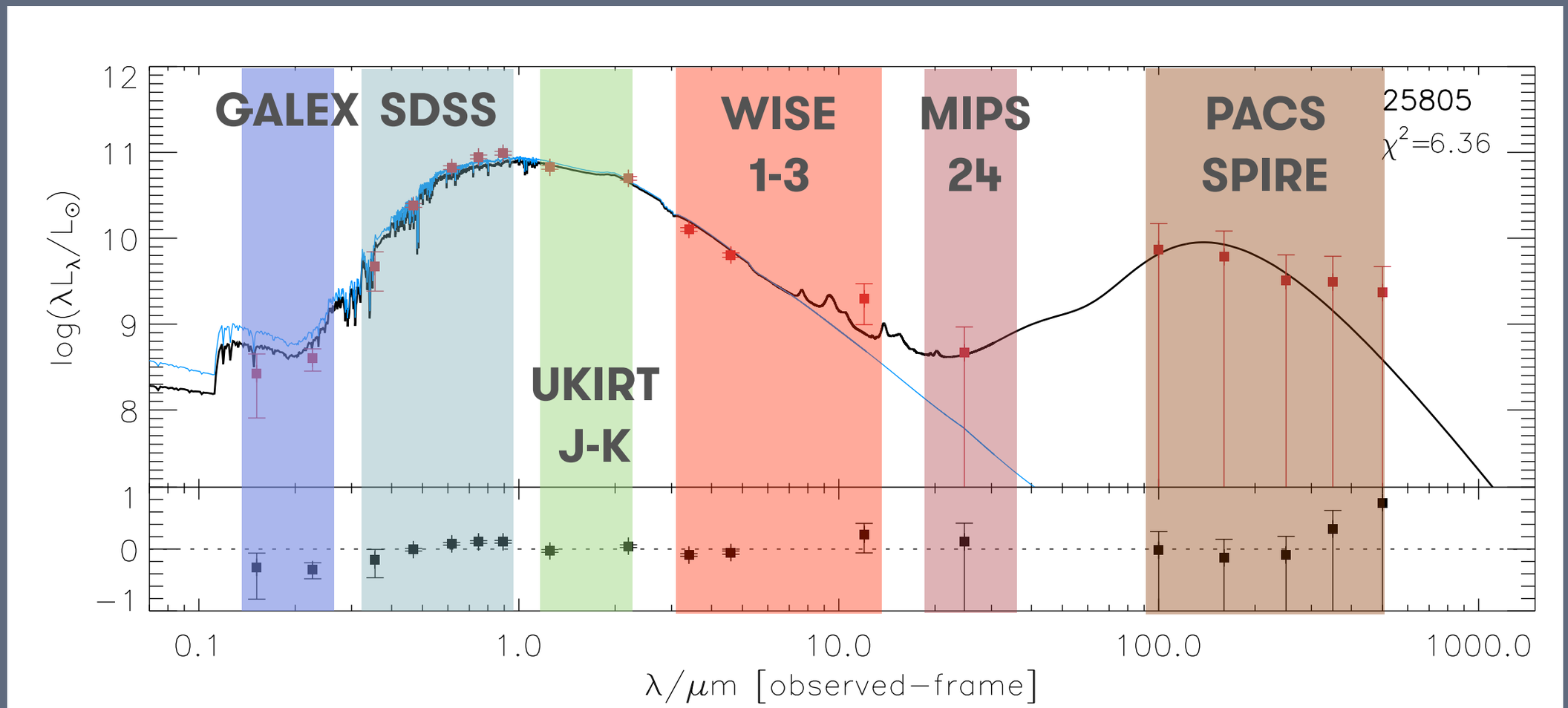
($M_* > 2 \times 10^{10}\ M_\odot$)

Results: fraction of SF galaxies



MB+ 17

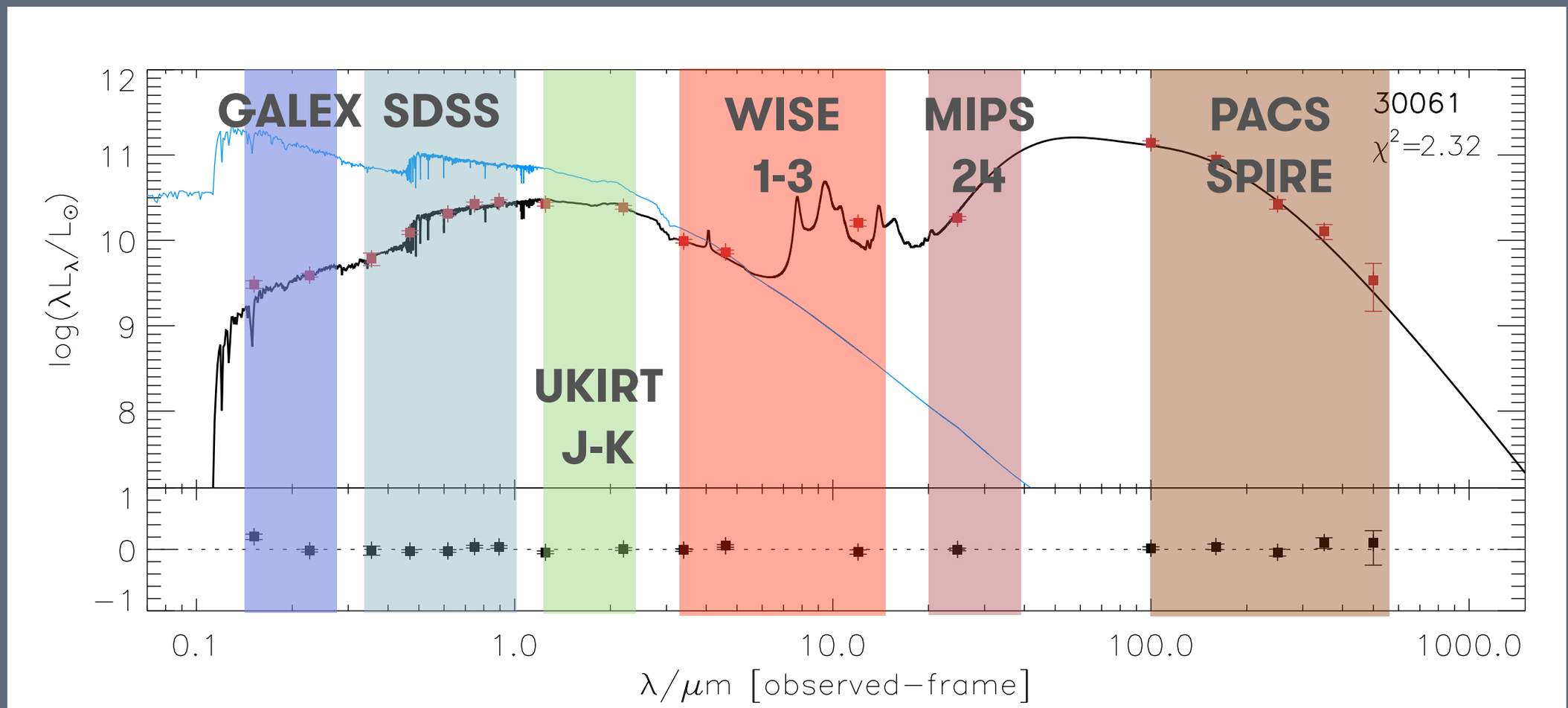
Results: dust mass



SED fit with MAGPHYS (da Cunha+08)

Passive galaxy

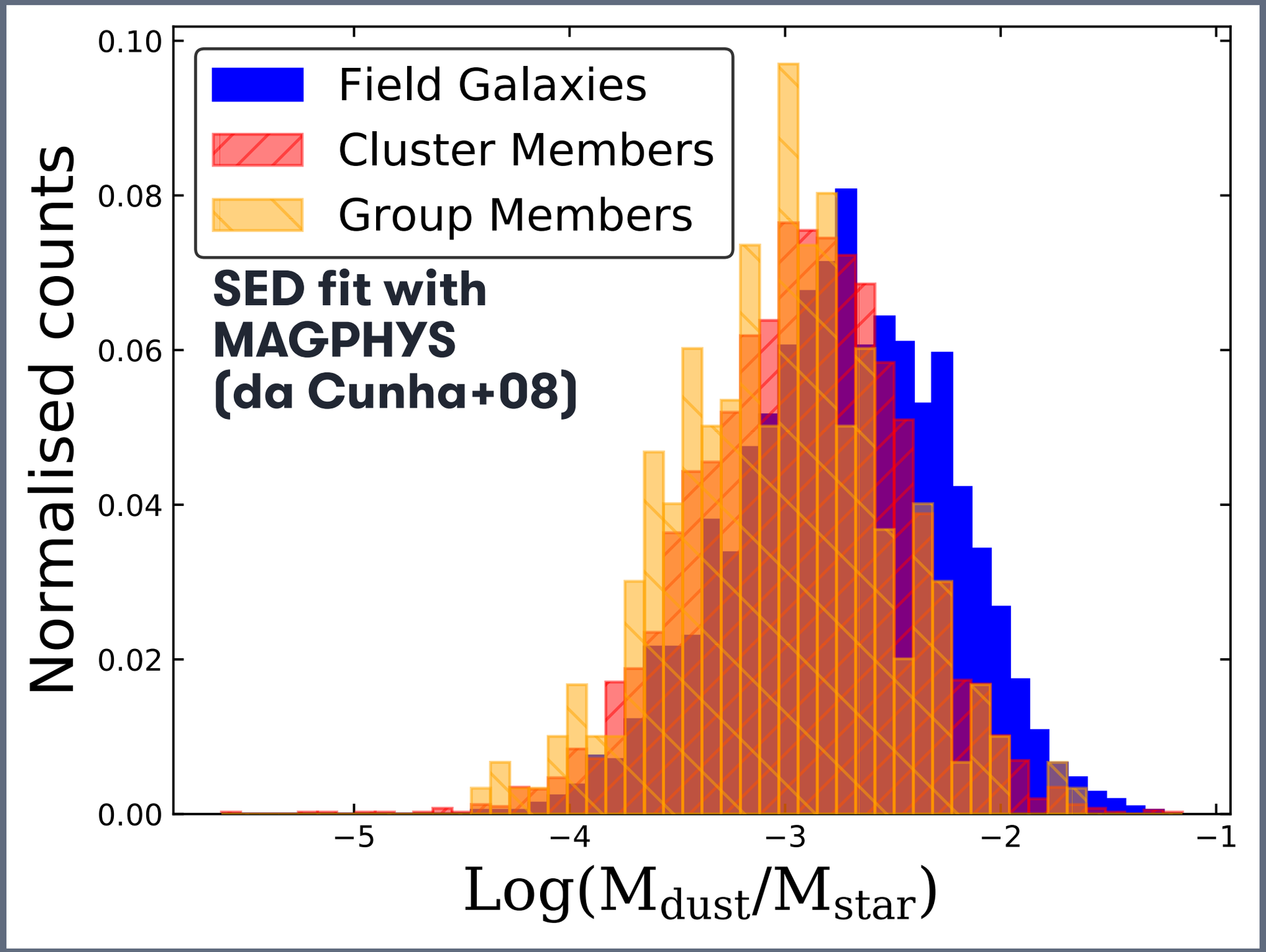
Results: dust mass



SED fit with MAGPHYS (da Cunha+08)

SF galaxy

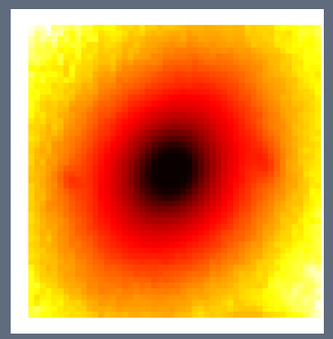
Results: dust mass

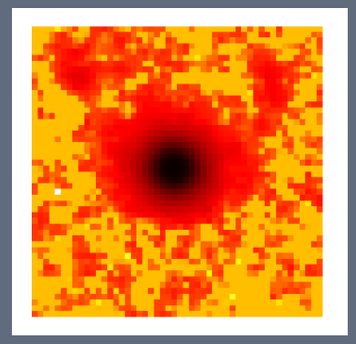


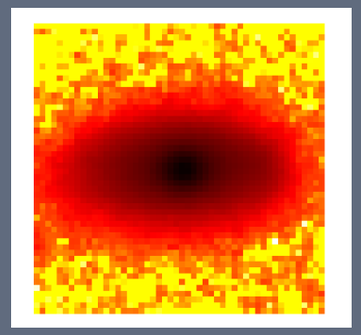
Results: morphology

SUBARU V+i' imaging (seeing ≈ 0.7")

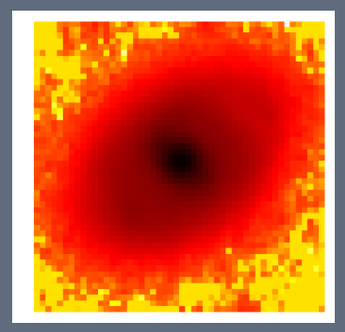
Ellipticals/Spheroidals

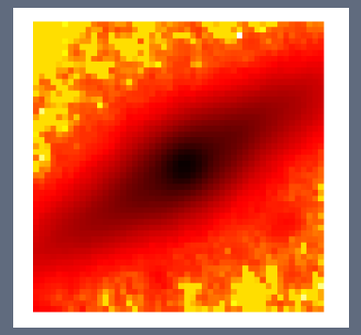


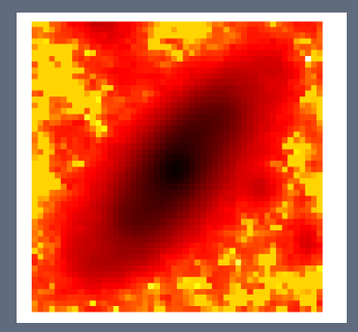




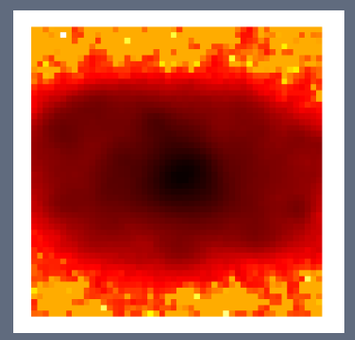
Late Type Discs







Irregulars



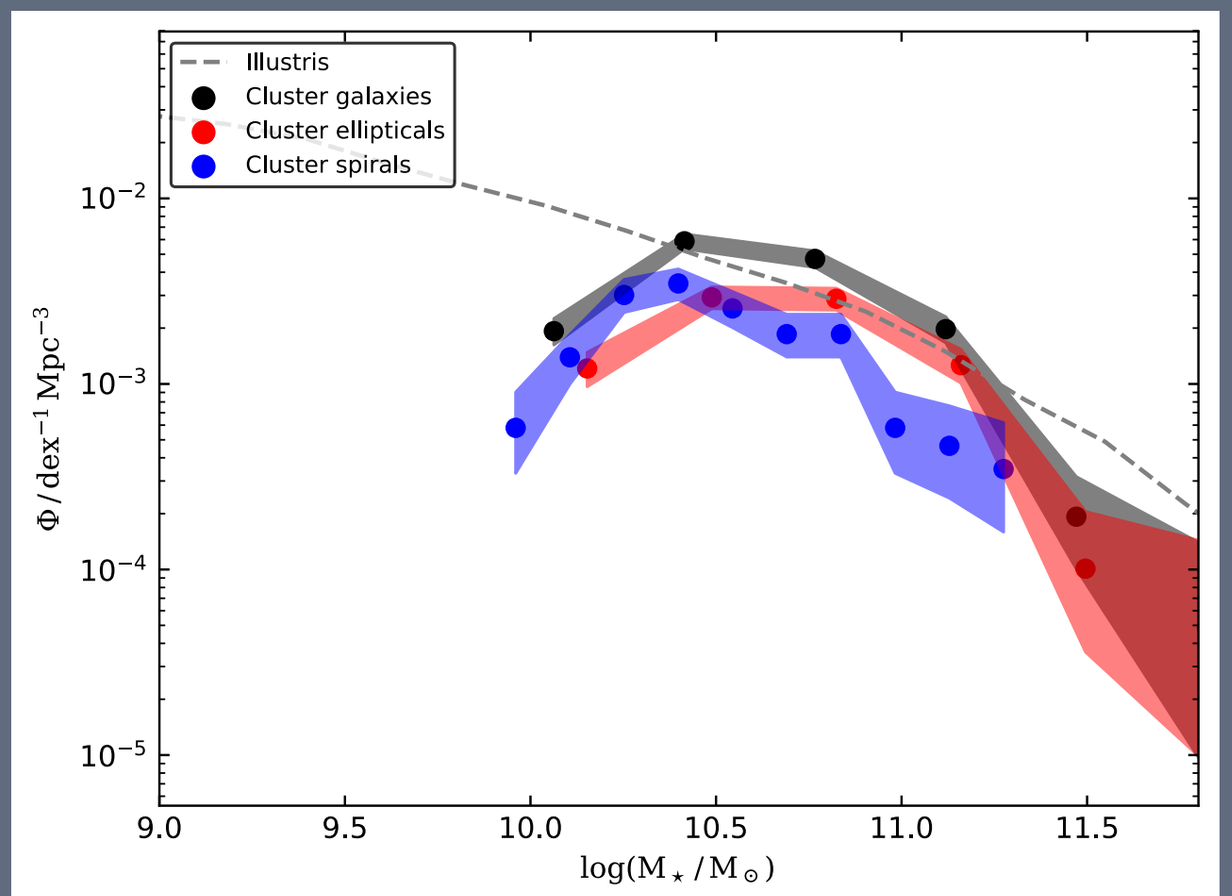
MB, Luoma, AF, GPS, CH+ in prep.

Lack of tidal features?

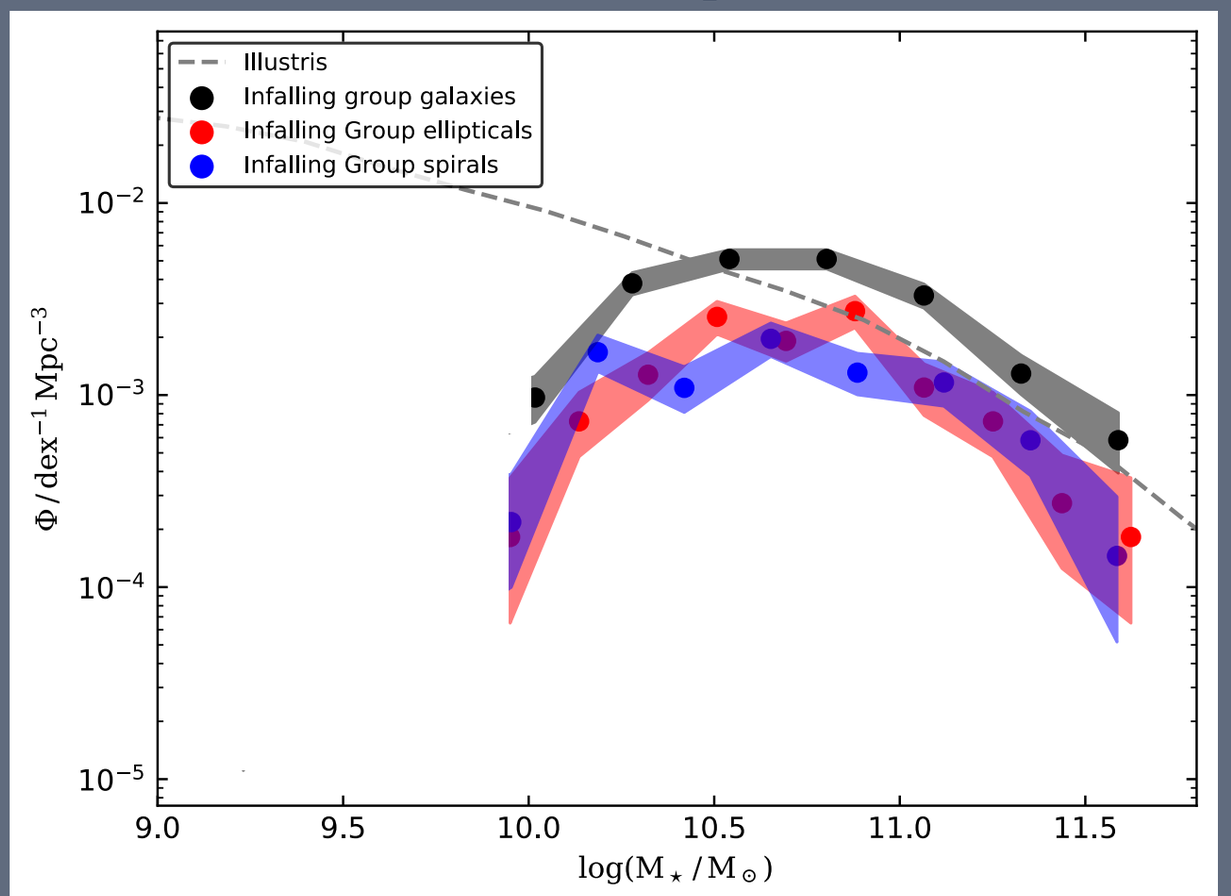
Results: morphology

Stellar mass function

Cluster



Groups



MB, Luoma, AF, GPS, CH+ in prep.

Conclusions

- **Unique dataset and controlled sample of galaxies**

- **Fraction of SF galaxies is lower in groups than in clusters at same clustercentric distance**

- **Flatter trend of SF fraction in groups than in clusters with respect to clustercentric distance**

- **Direct evidences of pre-processing in groups**
- **Groups are populating clusters with passive galaxies**

Future prospects

- Comparison with isolated groups
- Morphological decomposition
- Effect of cluster halo?

Thank you for your attention

Matteo Bianconi

Birmingham, 21st Sep