YOUNG MASSIVE STAR CLUMPS IN LOCAL HIGH-REDSHIFT GALAXIES ANALOGUES

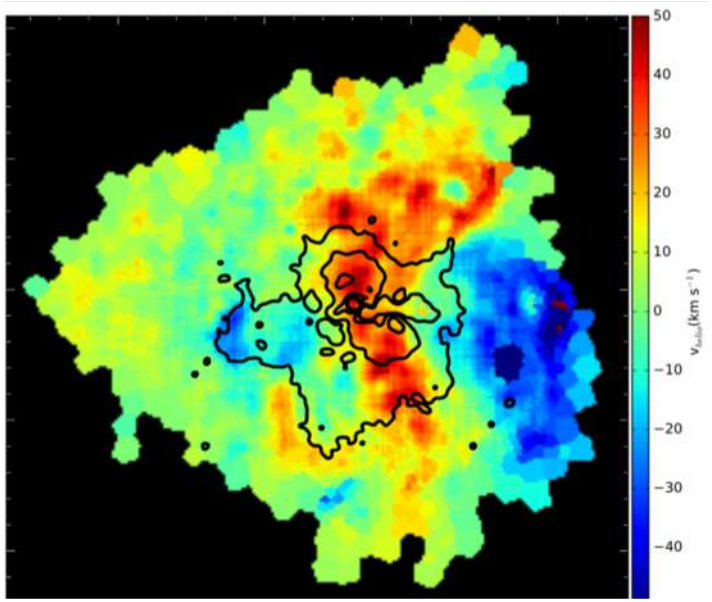
MATTEO MESSA, STOCKHOLM UNIVERSITY

A. ADAMO, G. ÖSTLIN, M. HAYES, J. MELINDER & THE LARS TEAM

Escape of Lyman radiation from galactic labyrinths 11-14 September 2018, OAC, Kolymbari, Crete

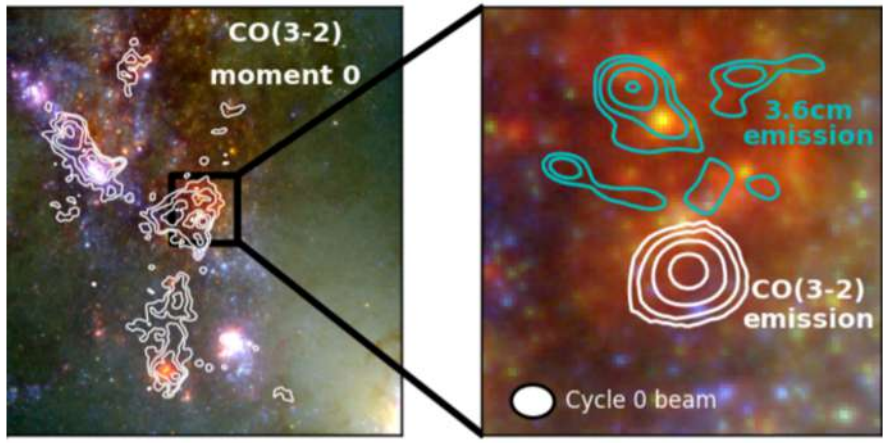
INTRODUCTION

- Massive star clusters is where most of the ionizing radiation is produced.
  - They provide the strongest feedback
  - They are gas-dense regions
    - Not clear how/if clumpiness affects the escape of ionizing radiation



Velocity map of Ha in ESO 338-IG04
Bik+2015

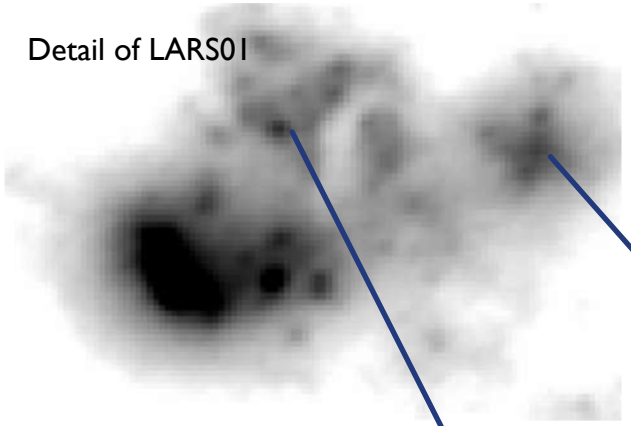
ESO 338-IG04
Bik+2015



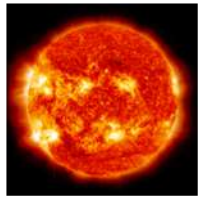
CO emission in the Antennae - Johnson+2015

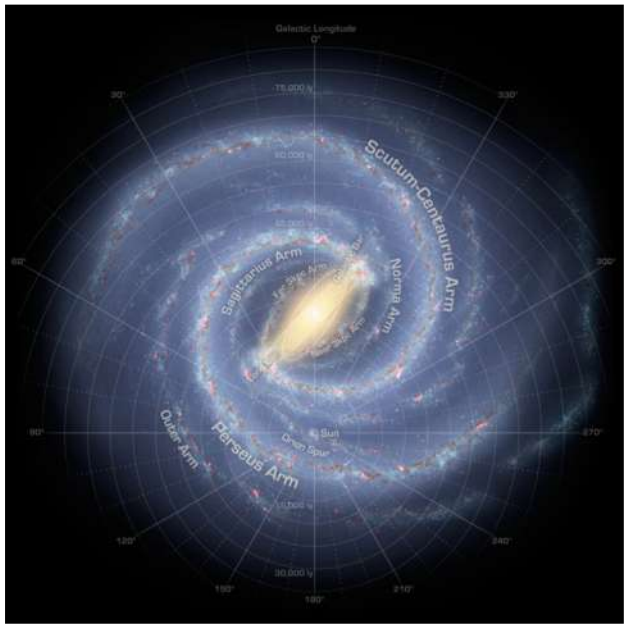
INTRODUCTION

Detail of LARS01



Range of clump sizes covered by our study on LARS galaxies:
~10 – 500 pc





~ 1 pc

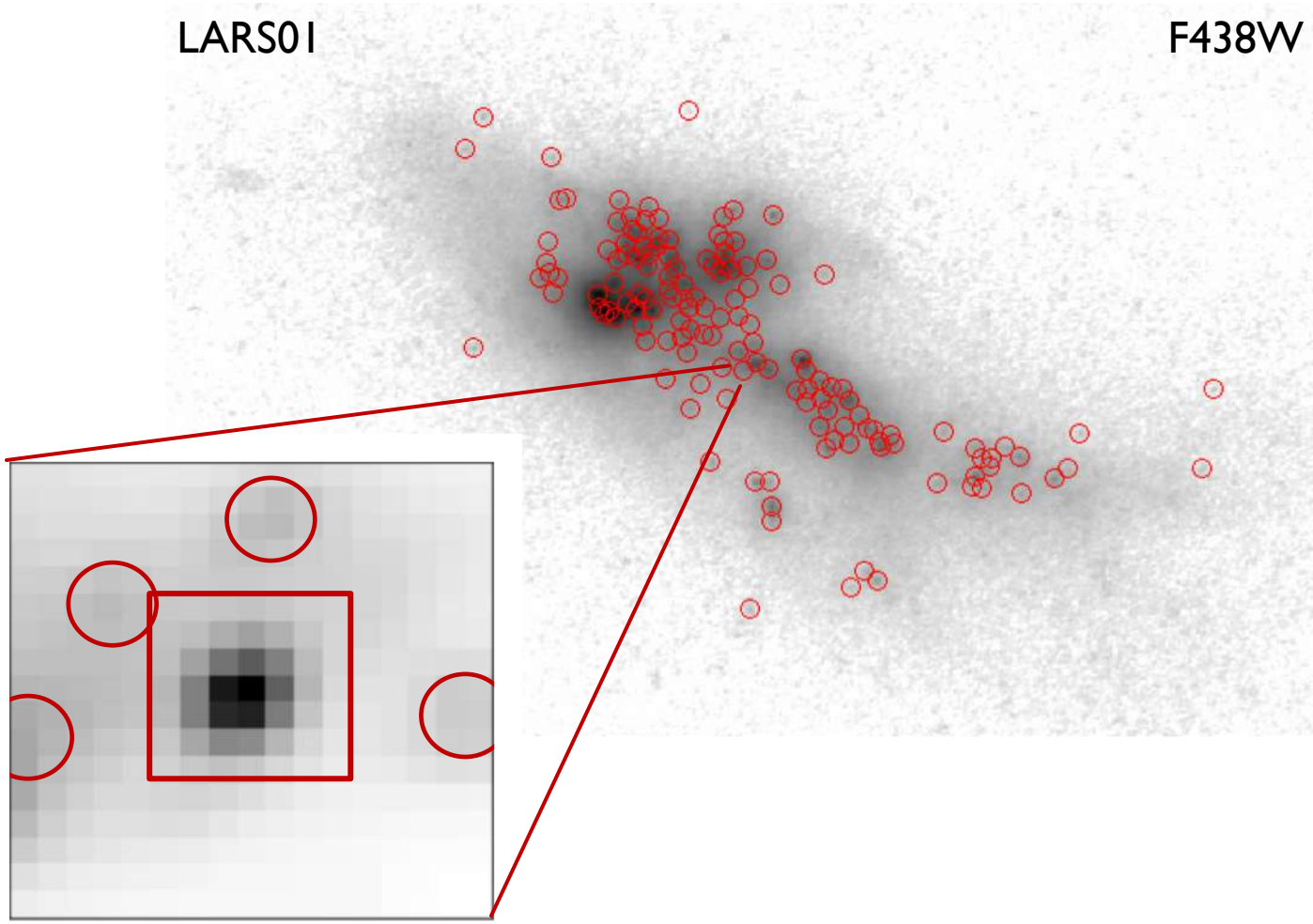
clusters
1-10 pc

clumps – SF regions
10 - 1000 pc

~ 10 kpc

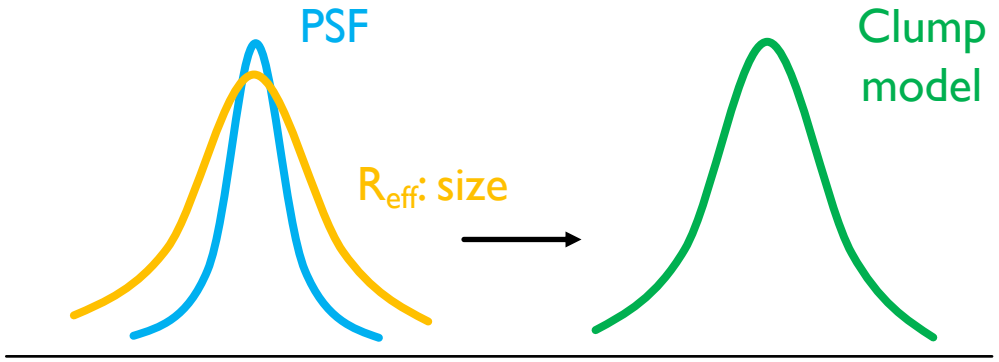
DATA ANALYSIS

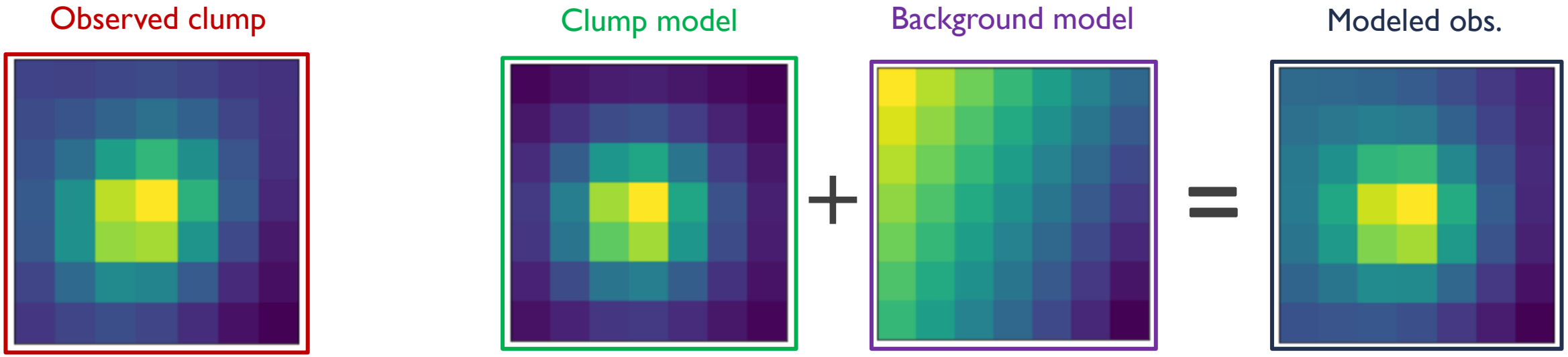
- Clump extraction: ref. B-Band
- Photometry:



DATA ANALYSIS

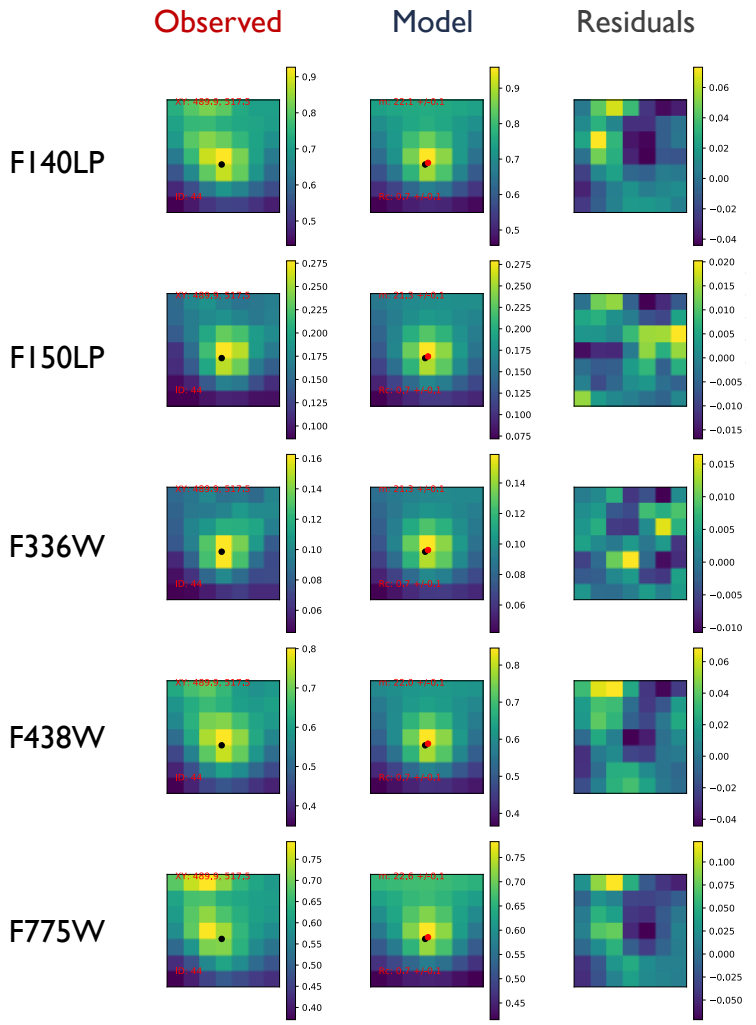
- Clump extraction: ref. B-Band
- Photometry:
  - Clump model = PSF x moffat
  - Background = polynomial (1st order)



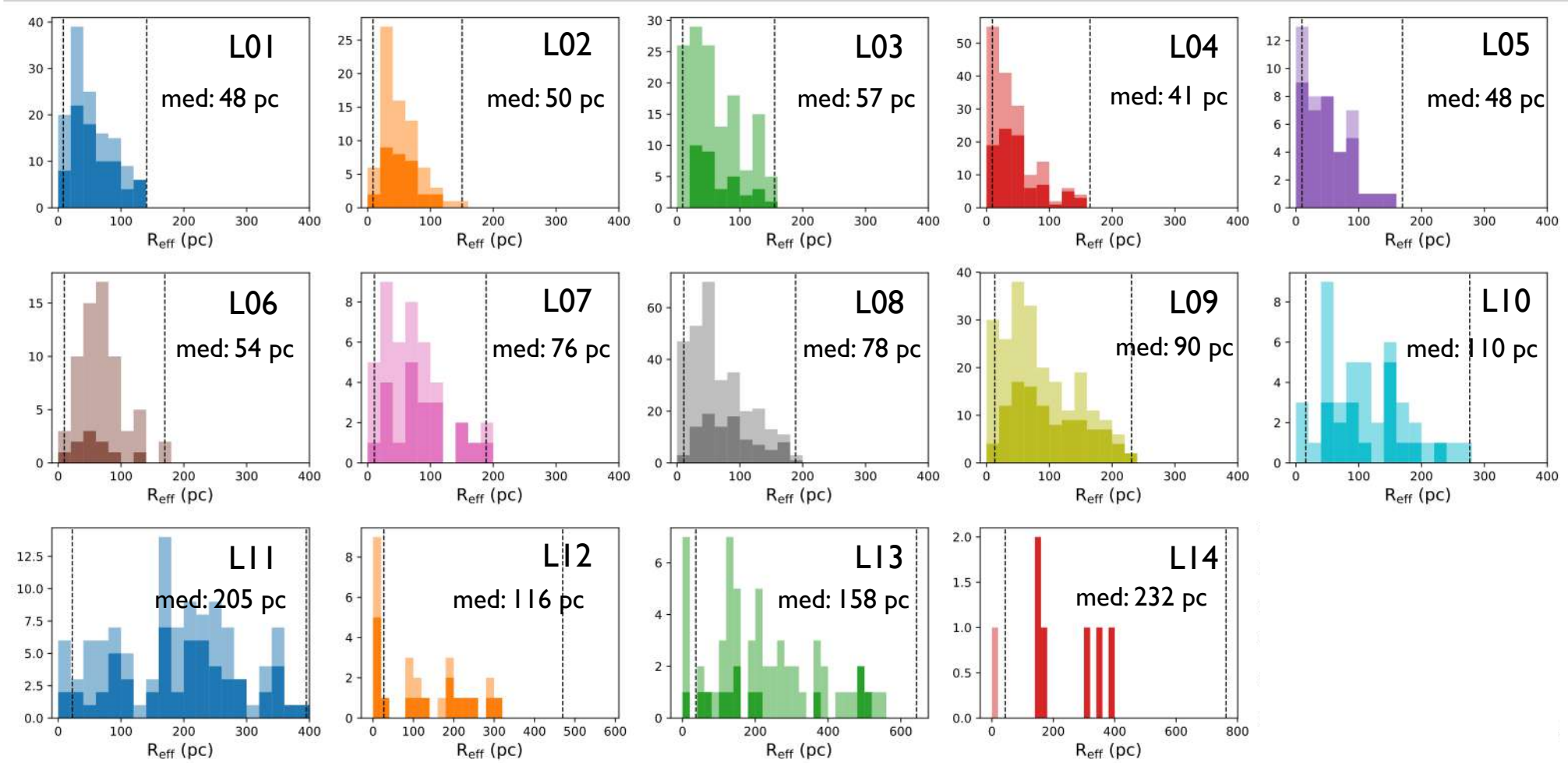


DATA ANALYSIS

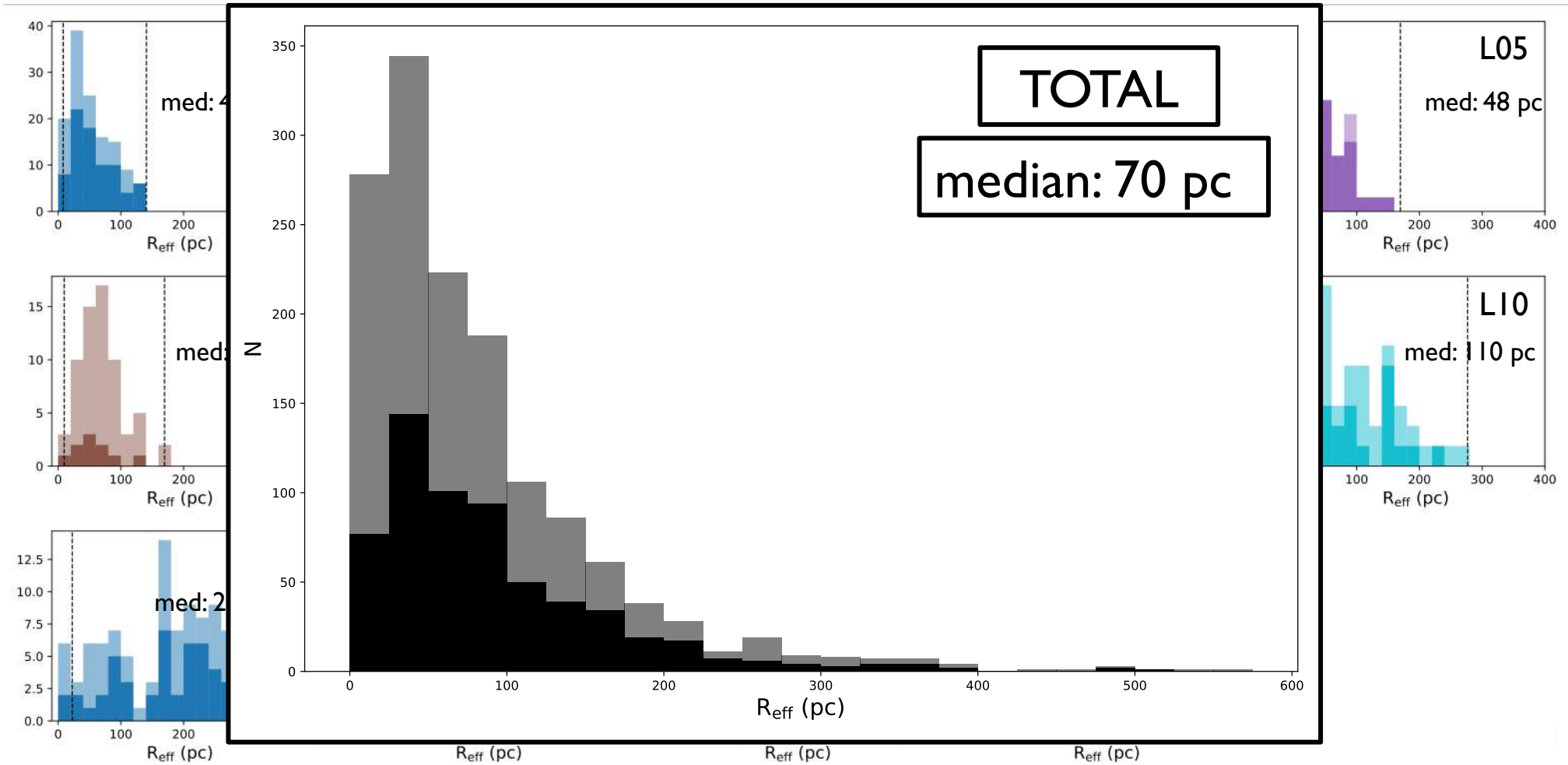
- Clump extraction: ref. B-Band
- Photometry:
  - Clump model = PSF x moffat
  - Background = polynomial (1st order)
  - Fit flux in 5 filters with same size
    - Best-value and uncertainties via MCMC
- ~1400 clumps (~600 with phot err < 0.3 mag in 5 bands)



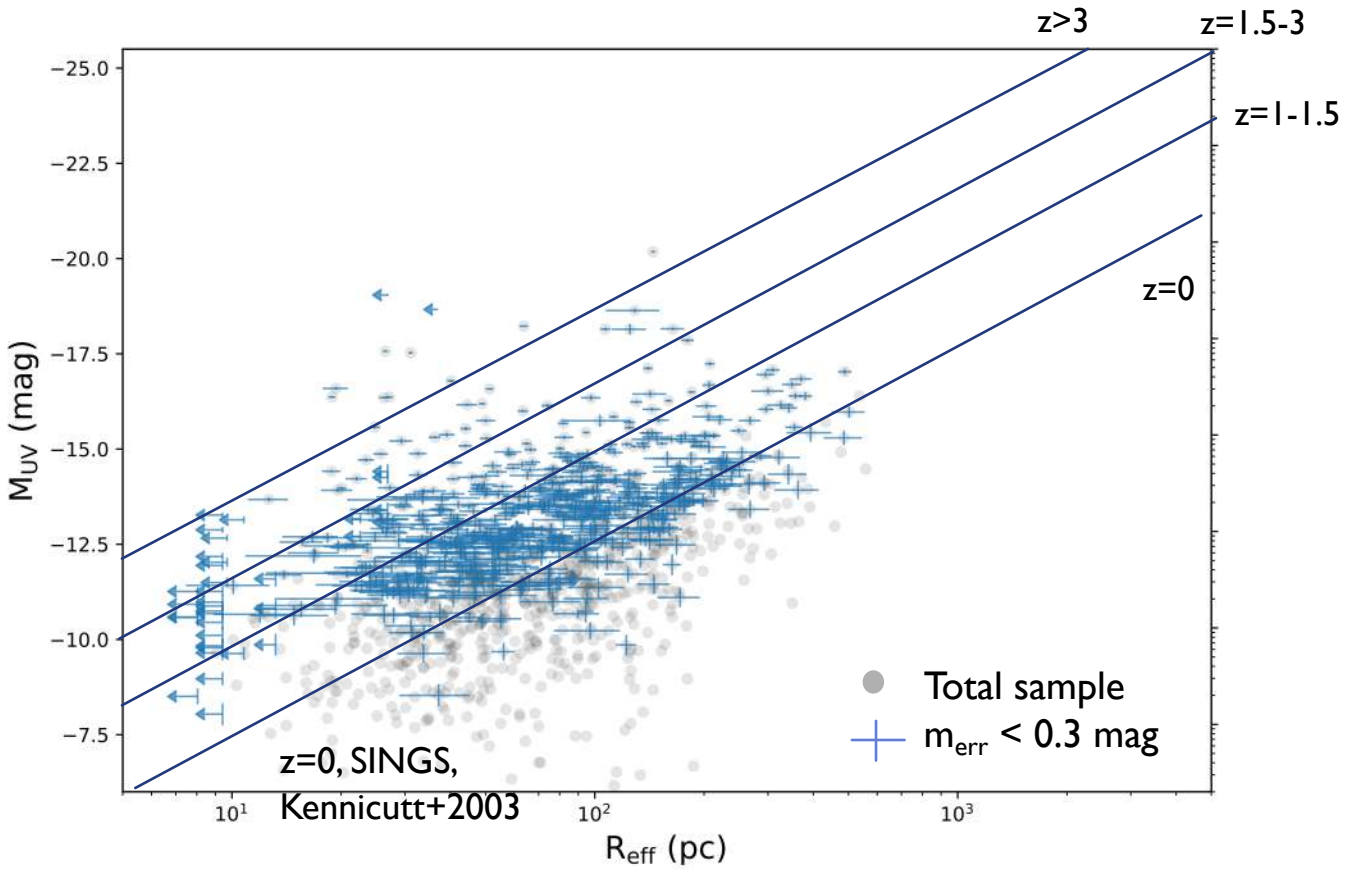
SIZES


L01
med: 48 pc
L02
med: 50 pc
L03
med: 57 pc
L04
med: 41 pc
L05
med: 48 pc
L06
med: 54 pc
L07
med: 76 pc
L08
med: 78 pc
L09
med: 90 pc
L10
med: 110 pc
L11
med: 205 pc
L12
med: 116 pc
L13
med: 158 pc
L14
med: 232 pc
Reff (pc)

SIZES

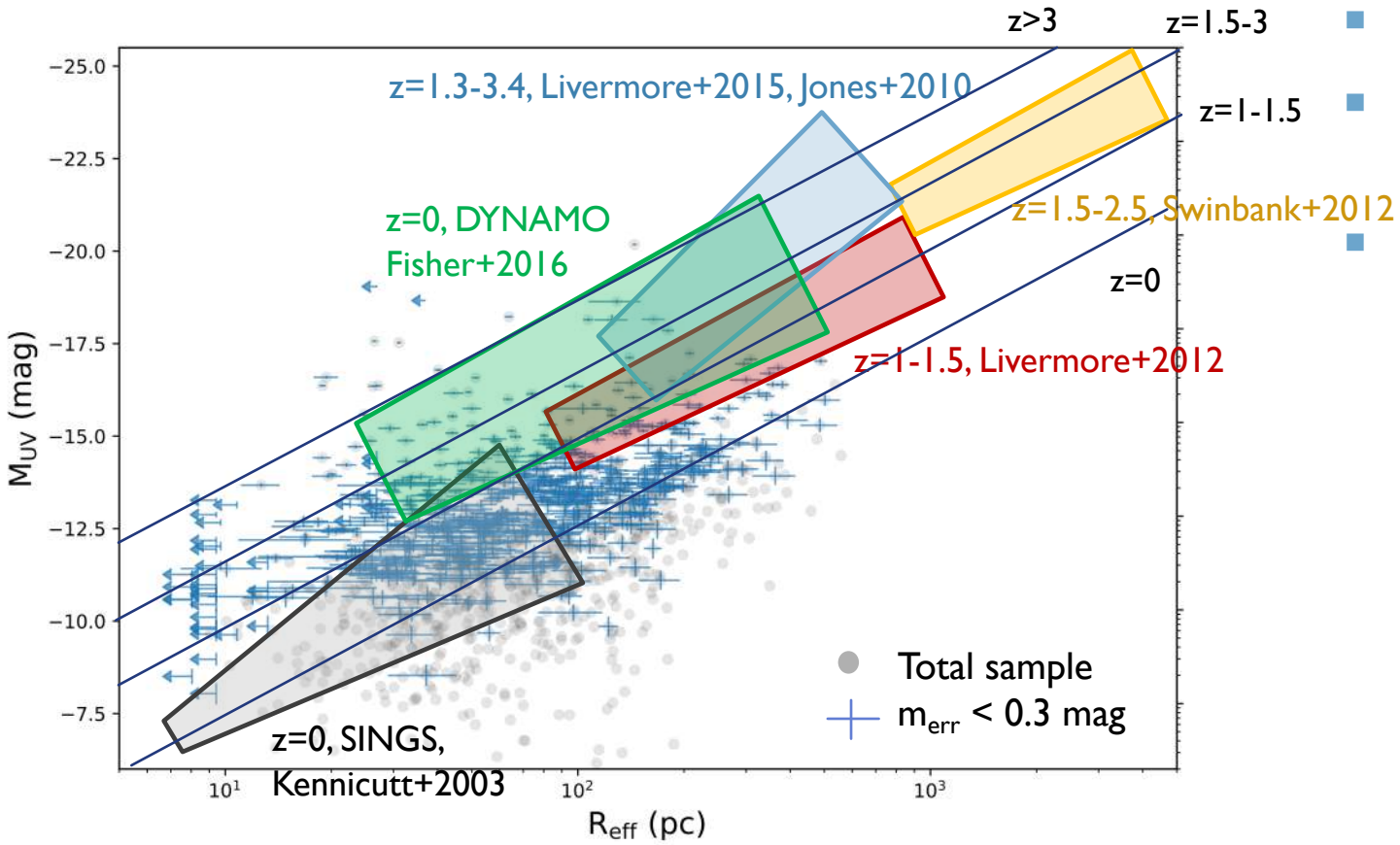

TOTAL
median: 70 pc
N
R_{eff} (pc)
L05
med: 48 pc
L10
med: 110 pc
med: 4
med:
med: 2

SIZE-LUMINOSITY



- Scatter: different densities
- Bulk similar to what is observed in clumps at z=0 (SINGS, Kennicutt+2003)
- Extending to SFR densities observed in clumps at high-redshift
  - at smaller sizes

SIZE-LUMINOSITY



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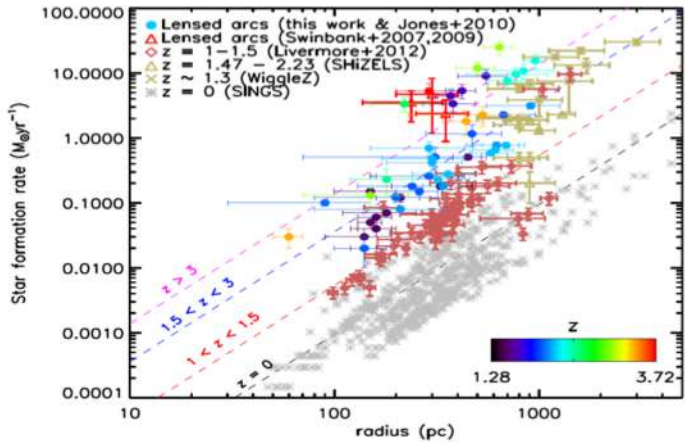
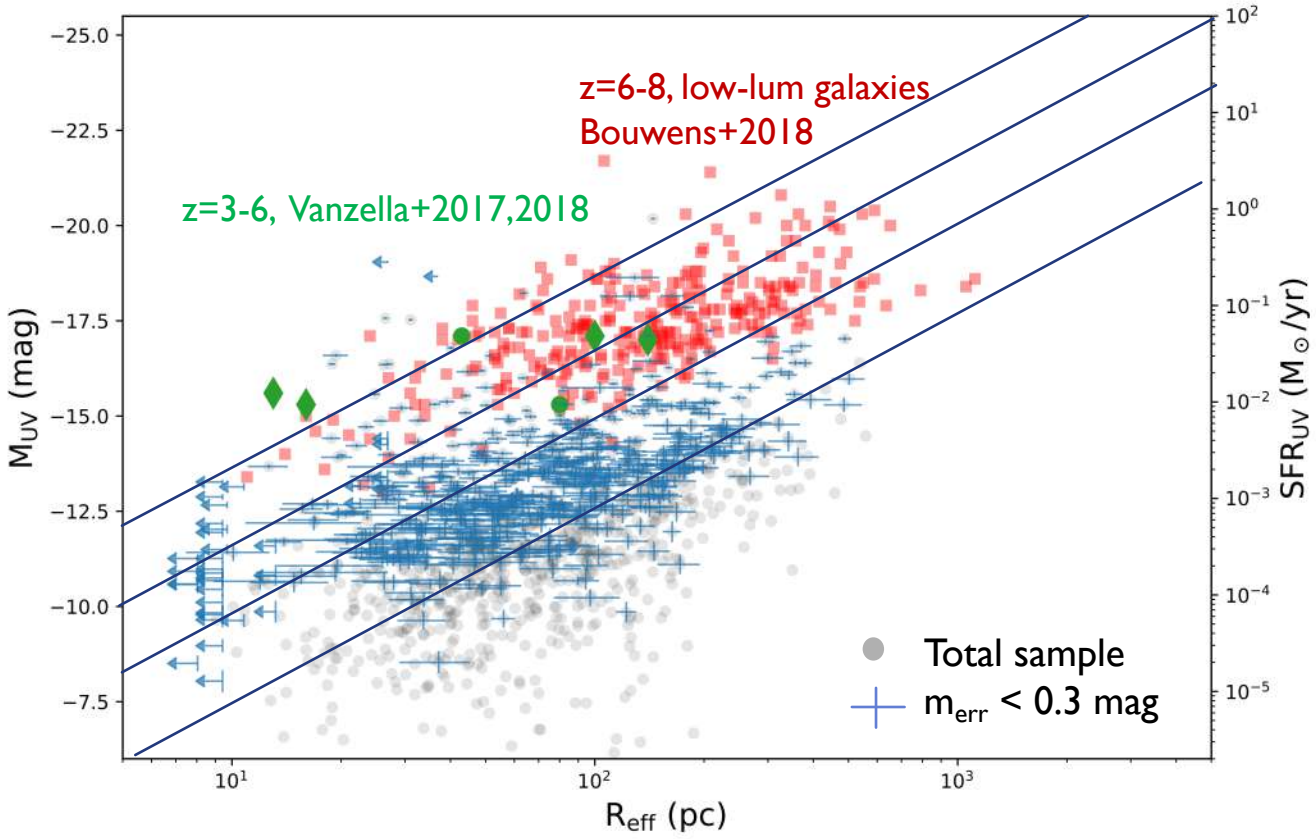


Livermore+2015

SIZE-LUMINOSITY

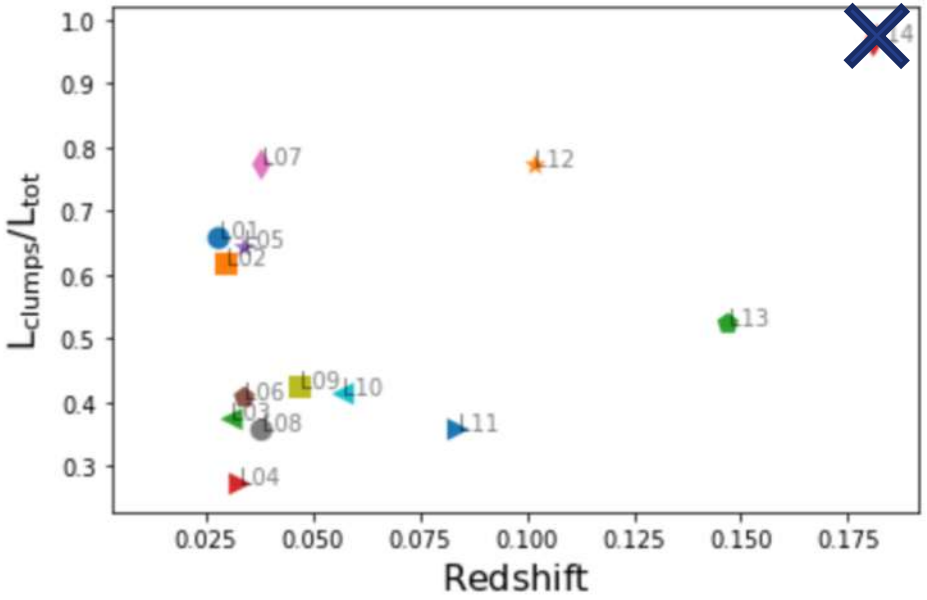


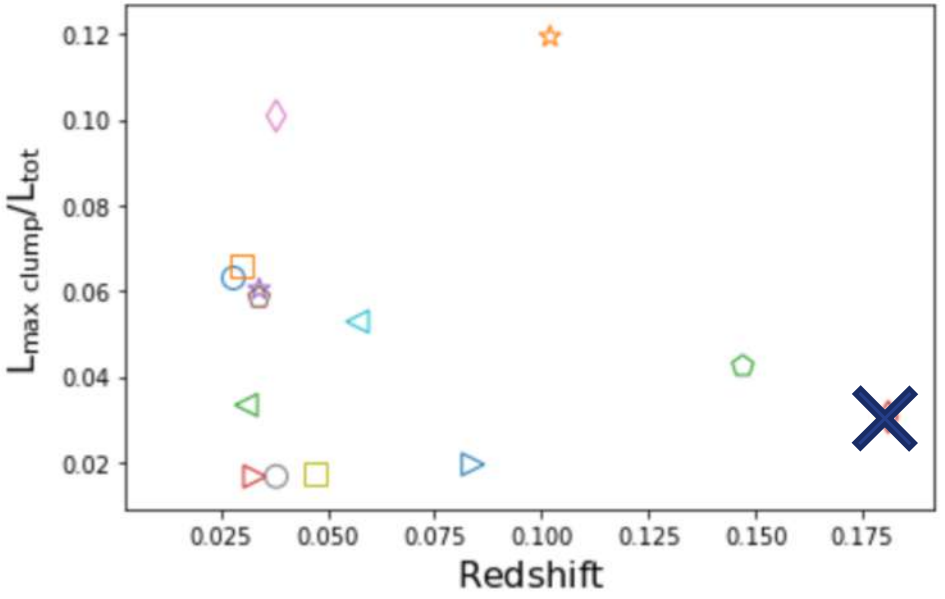
- Scatter: different densities
- Bulk similar to what is observed in clumps at z=0 (SINGS, Kennicutt+2003)
- Extending to SFR densities observed in clumps at high-redshift
  - at smaller sizes
- Sizes and luminosities similar to low-lum galaxies and star-forming regions at redshift 3-8
  - Proto-globular clusters?

CLUMPINESS

- Parametrized in 2 ways:
  1. Fraction of galaxy UV light in clumps
  2. Fraction of galaxy UV light in the brightest clump (e.g. Guo+2015)

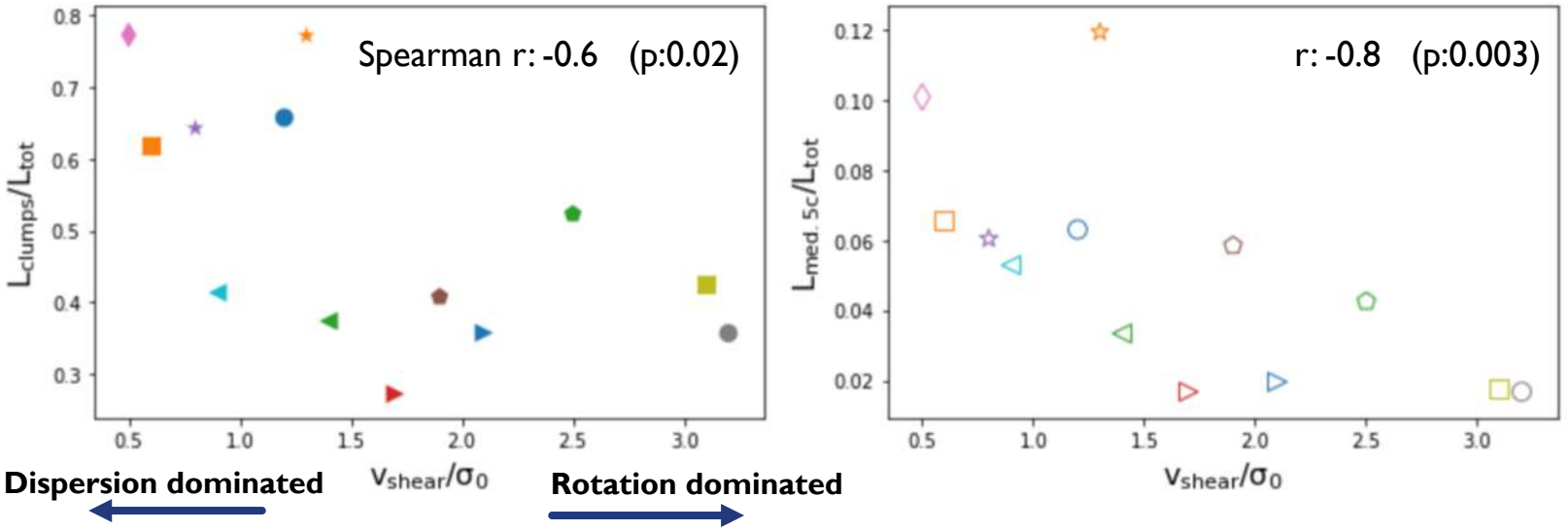
LARS14





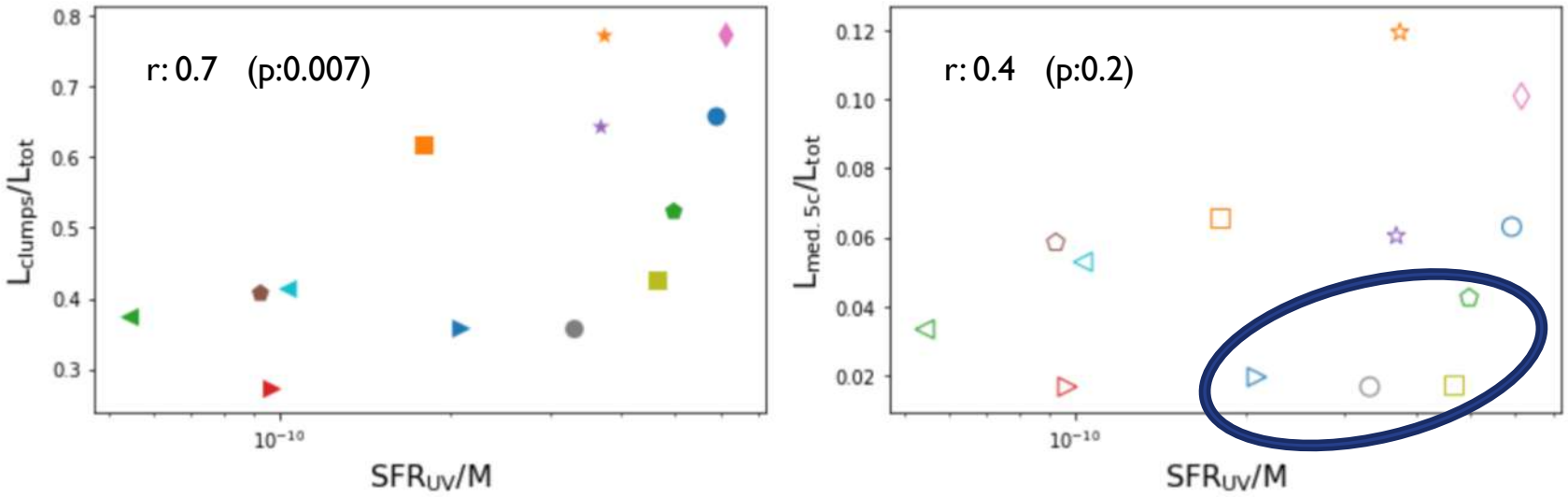
CLUMPINESS VS GALAXY PROPERTIES

- We find a tentative correlation with the gas dispersion
  - Parametrized by shear/dispersion velocities (see Herenz+2016)
  - More dispersion dominated galaxies → higher clumps contribution
- Similar to what found in recent works
  - LARS galaxies have more disturbed morphologies



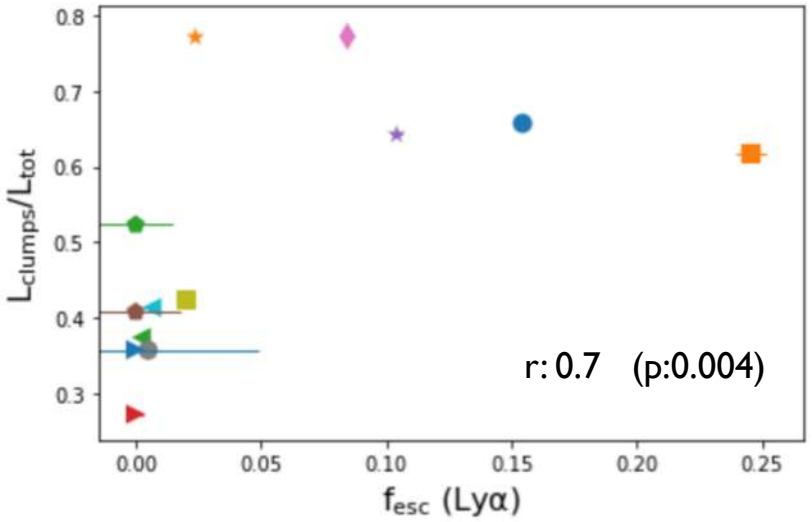
CLUMPINESS VS GALAXY PROPERTIES

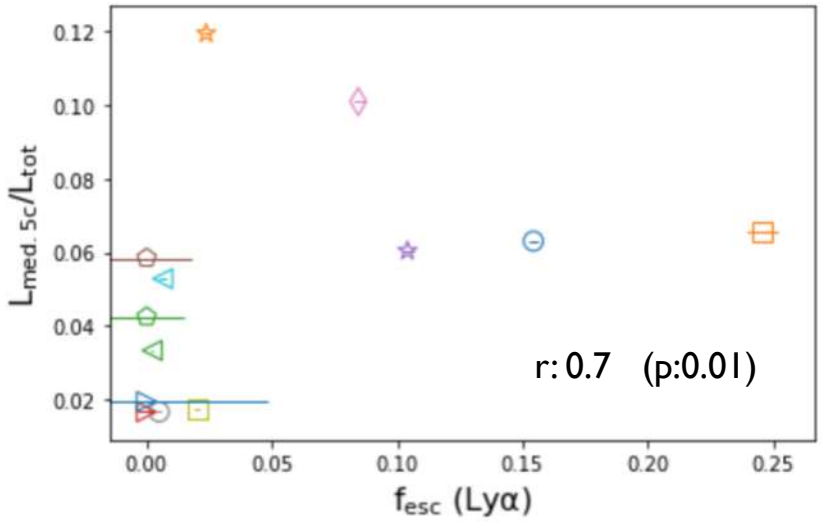
- We look for correlation with SFR properties :
  - Possible correlation with SFR/M
  - Highly SF galaxies with low L_{clump} fraction are rotation dominated



CLUMPINESS VS LINE PROPERTIES

- We try to relate the clumpiness with Lyα properties
  - Lyman-α escape fraction: galaxies with higher f_{esc} (Lyα) are more clumpy
  - The same is NOT seen when considering the EW(Lyα)





TAKE-HOME CONCLUSIONS

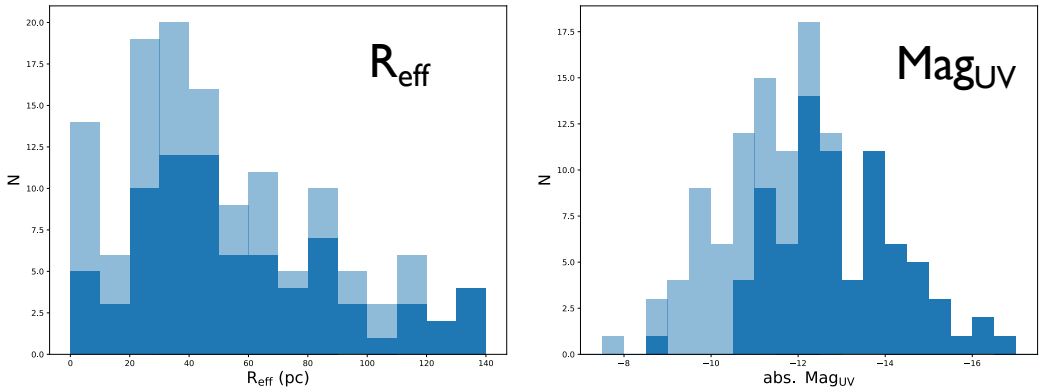
- Study of clumps in highly star-forming galaxies
  - Scales ~10 – 500 pc

- We observe clumps with densities that span the range of clump density observed in galaxies from z=0 to z>3
- Dispersion-dominated galaxies are more 'clumpy'
- Higher Lyα escape fraction seems to be associated to galaxies with higher clumpiness

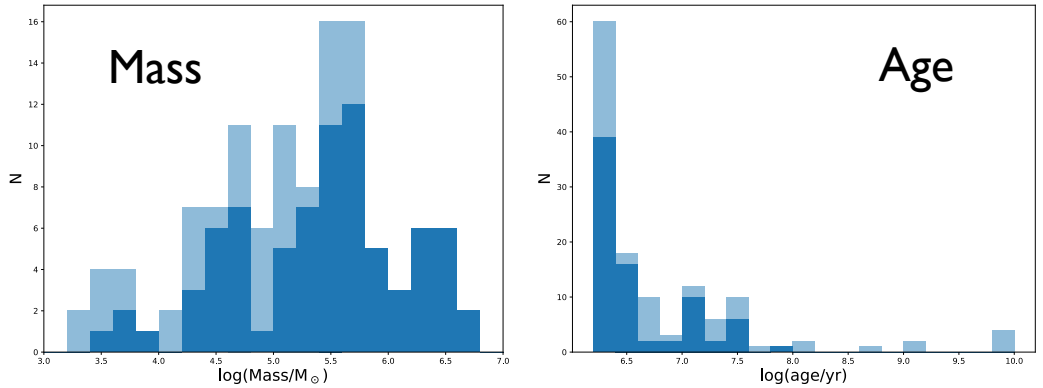
FUTURE WORK

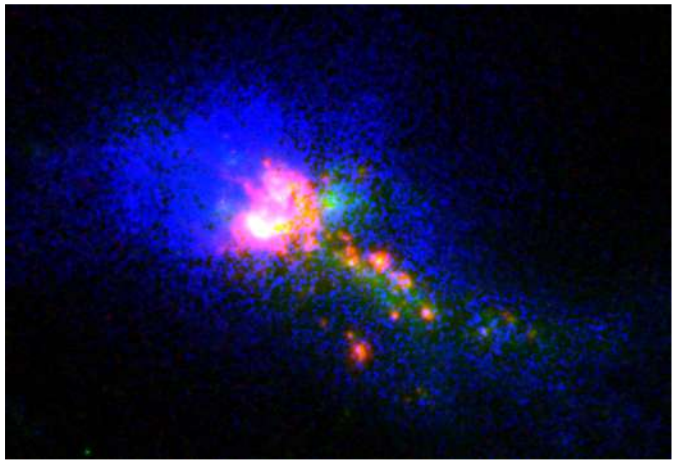
EXAMPLE: LARS01 GALAXY

From photometry



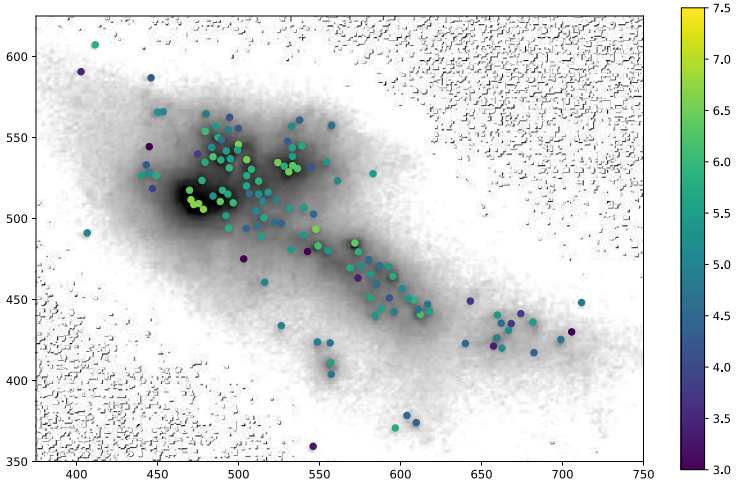
From SED fitting





Hα,Lyα

Mass



LyC