Clumpy Star Formation in Local Luminous Infrared Galaxies

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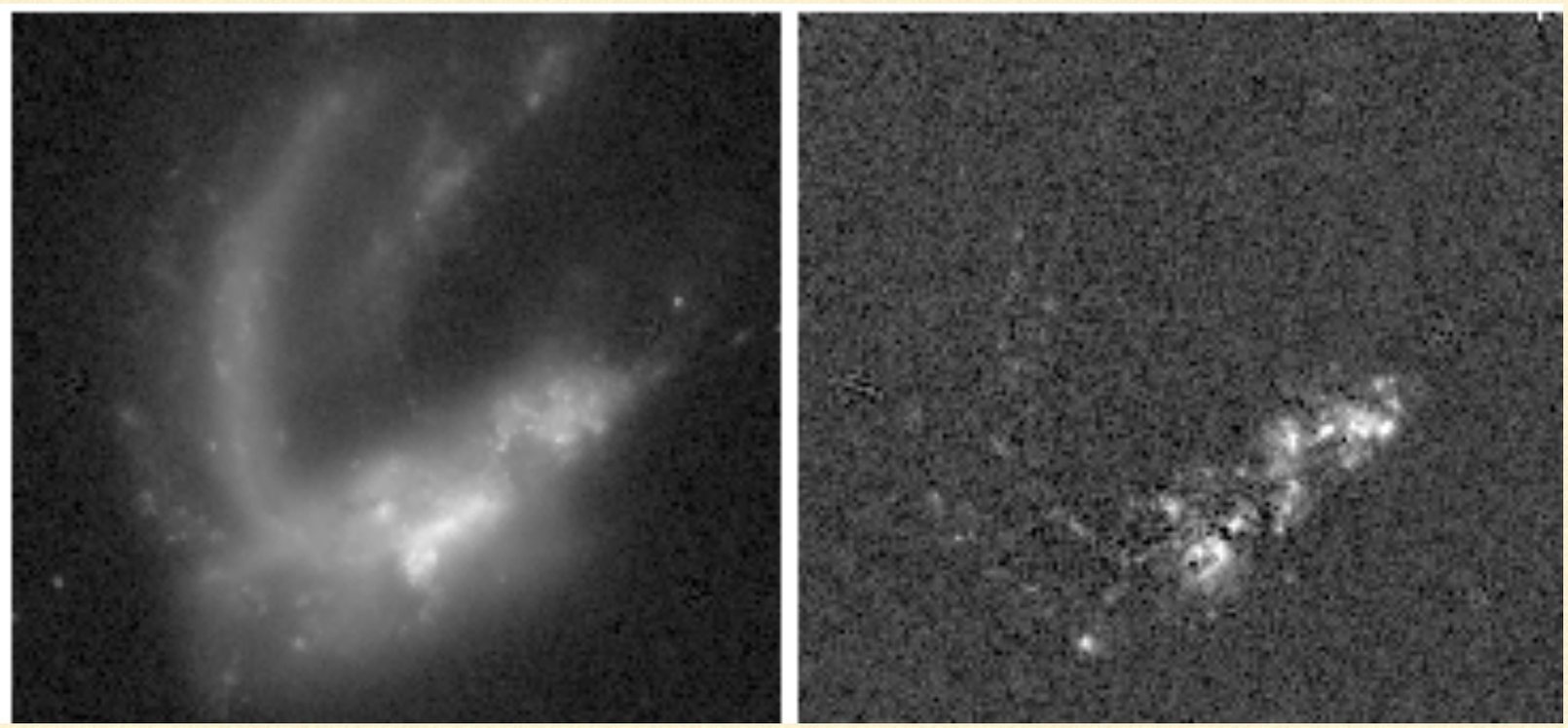
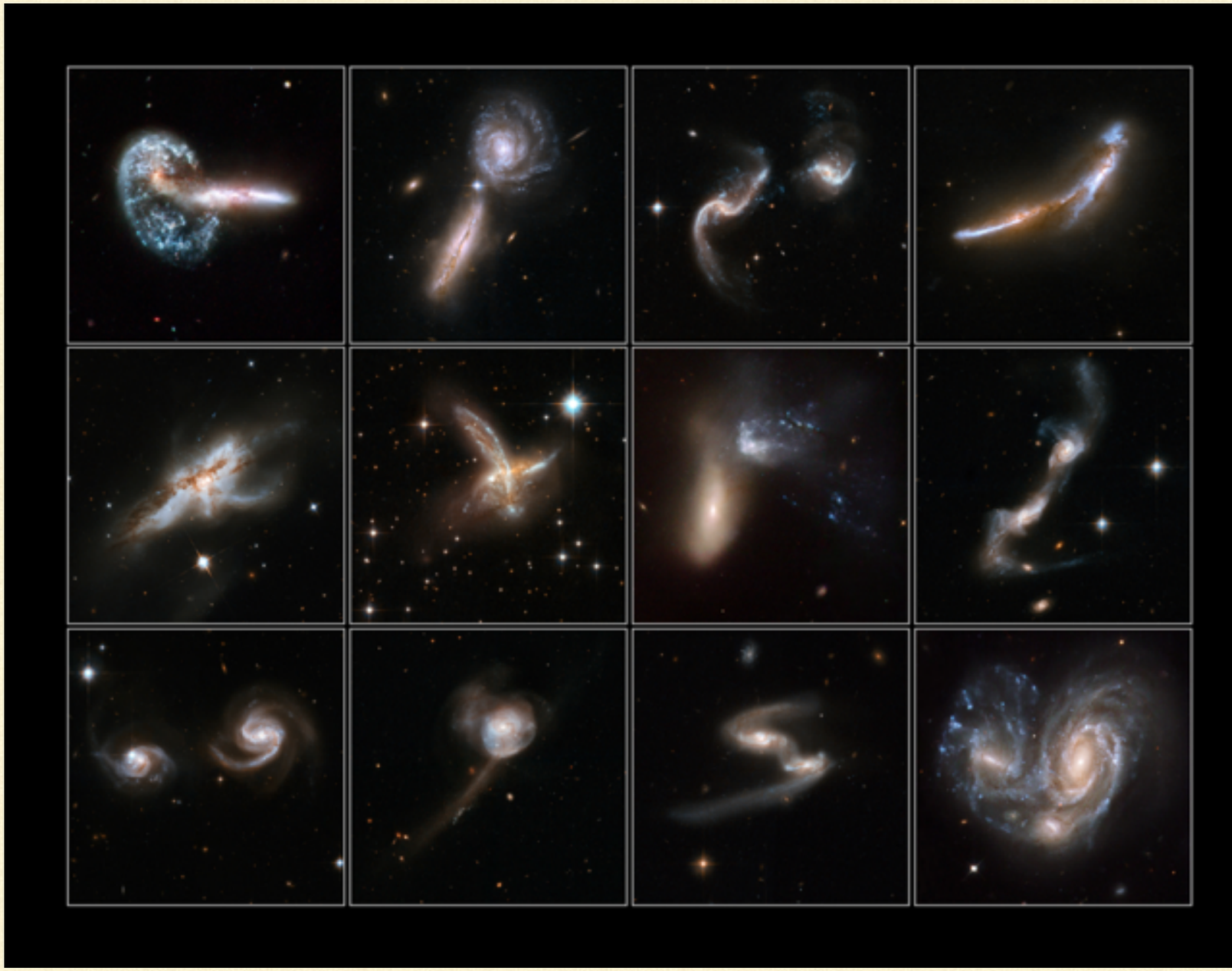


Great Observatory All-sky LIRG Survey

GOALS

- GOALS is a sample of 203 (U)LIRGs with $L_{IR} > 10^{11}$ $L_{\odot}$ and $z < 0.088$

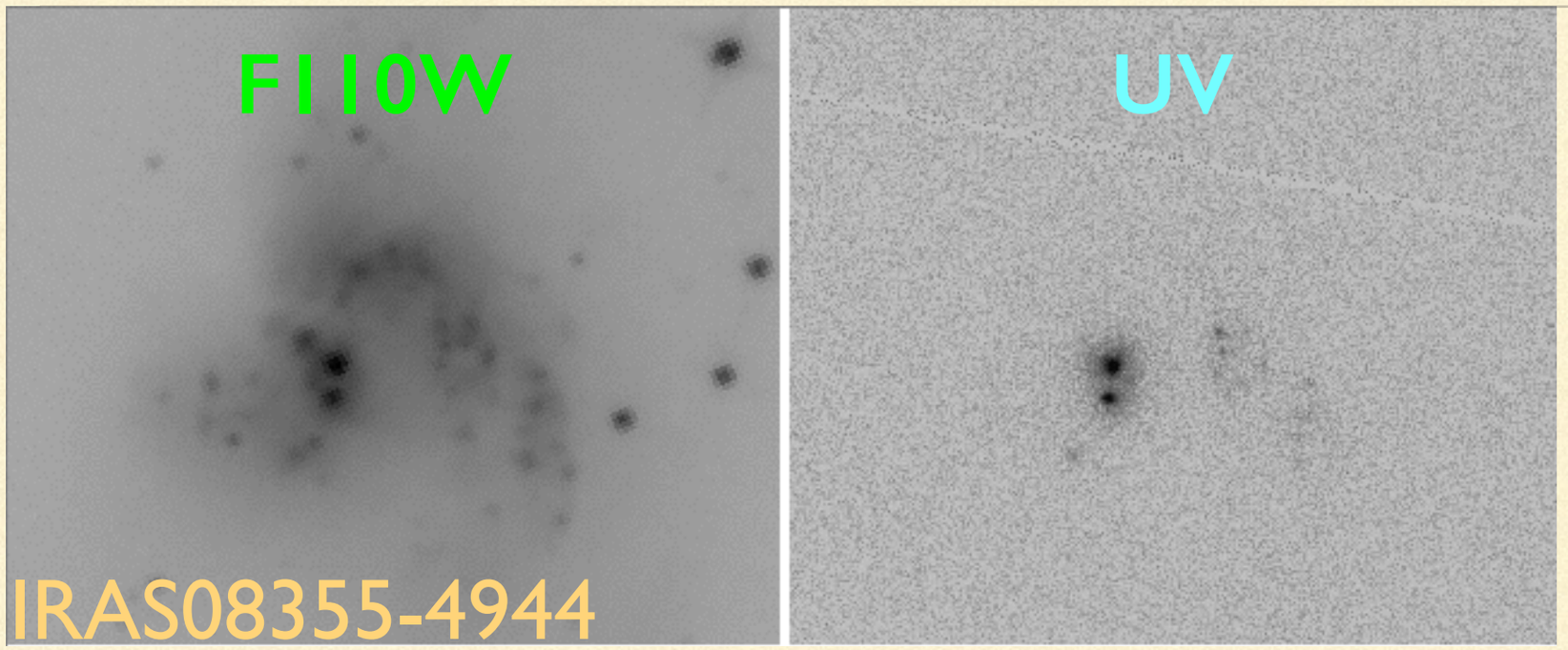
- Contains galaxies in every merger interaction stage



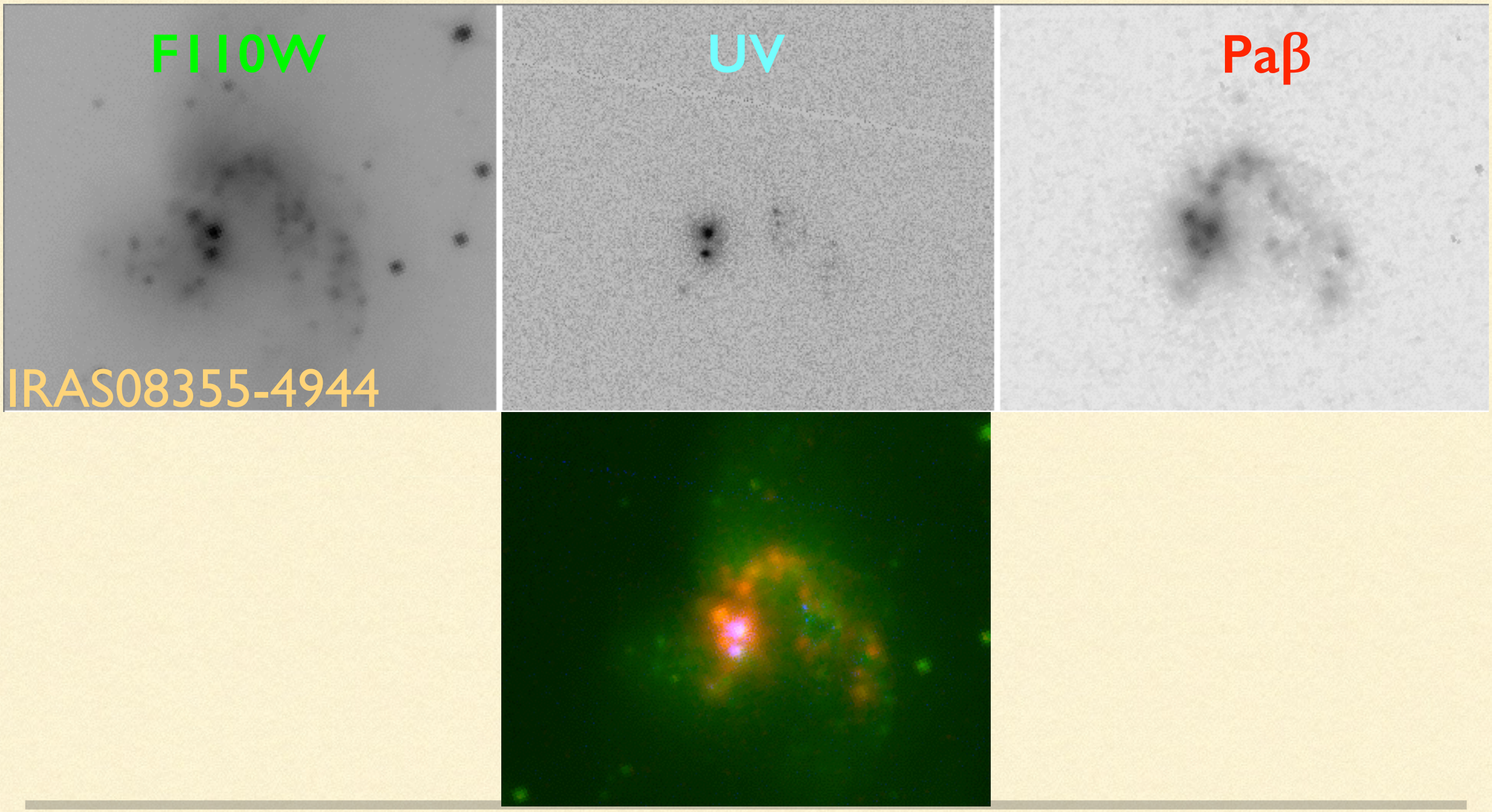
HST Paβ & Paα Imaging

- Target Paβ emission line with F132N filter of 24 LIRGS and Paα line with F190N for 30 LIRGS
- Study current(~5Myr) resolved star formation in LIRGS (<100pc)
  - Clumpy vs Diffuse emission
- How does the distribution of star formation change throughout the merger?
- Compare Size, Luminosities, SFR of clumps to local and high-z galaxies.
  - Does star formation in local LIRGS look more like high-z or local normal galaxies?

UV vs Paβ



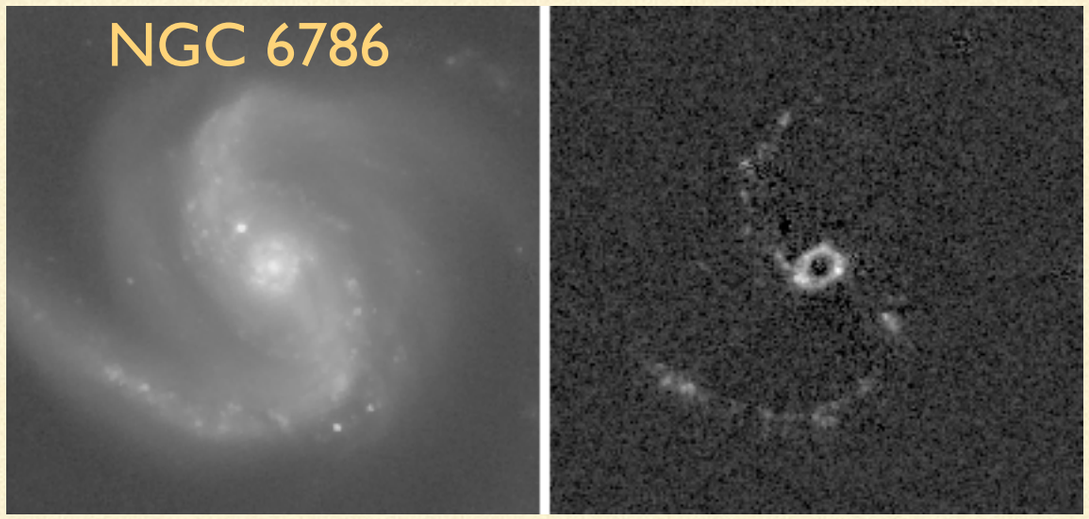
UV vs Paβ

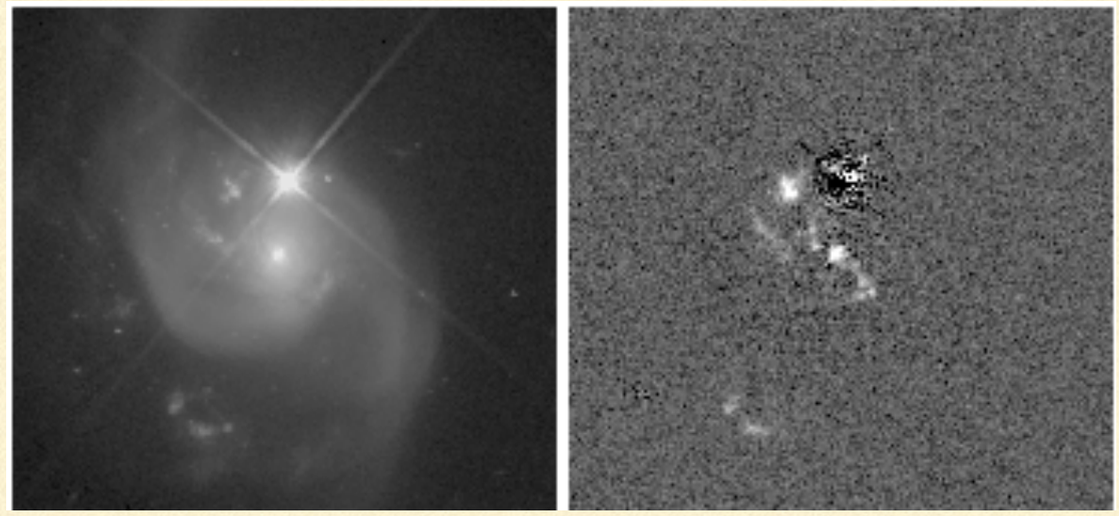


HST Paβ Imaging

F110W

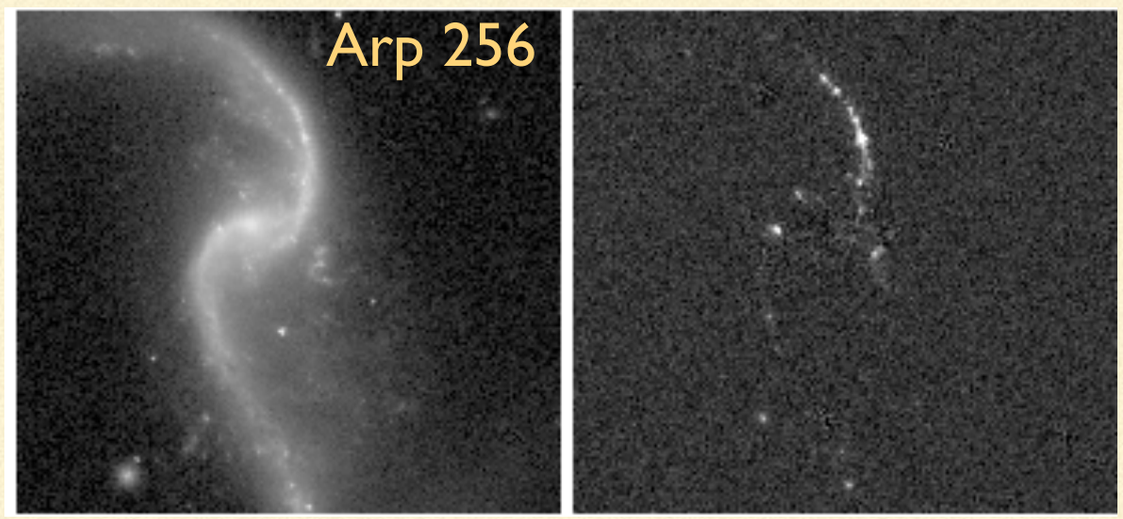
Paβ

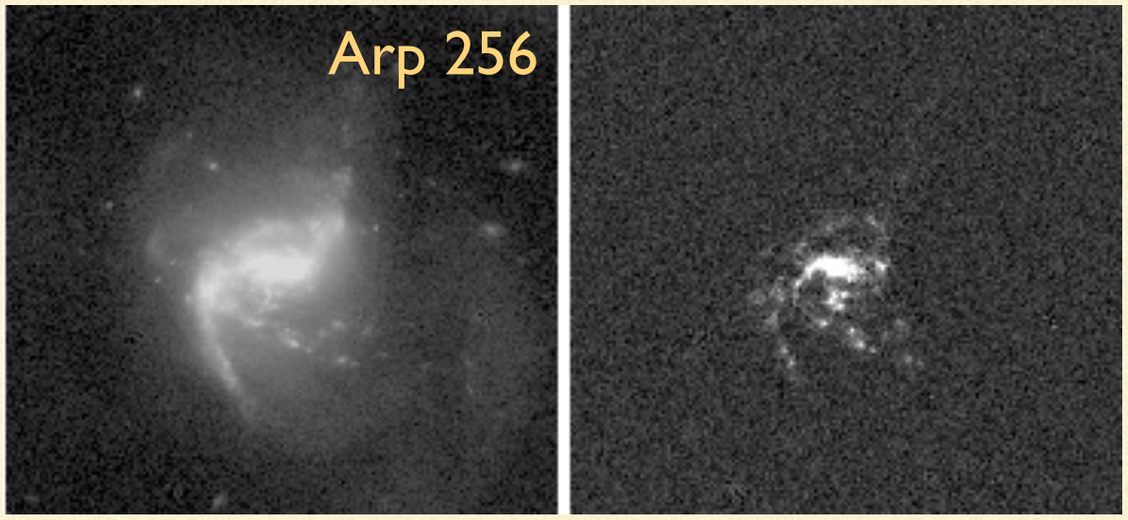




F110W

Paβ

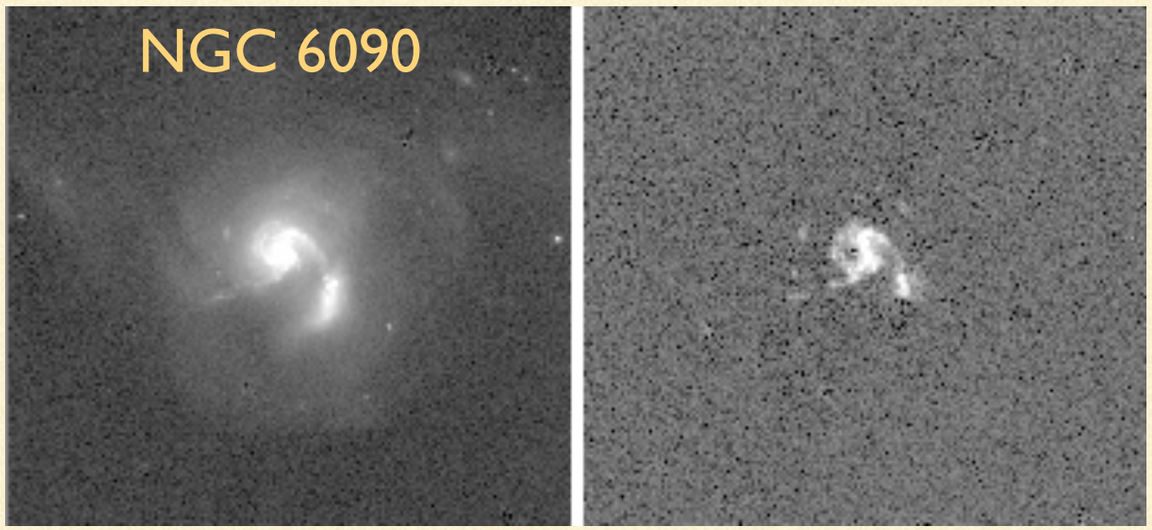




HST Paβ Imaging

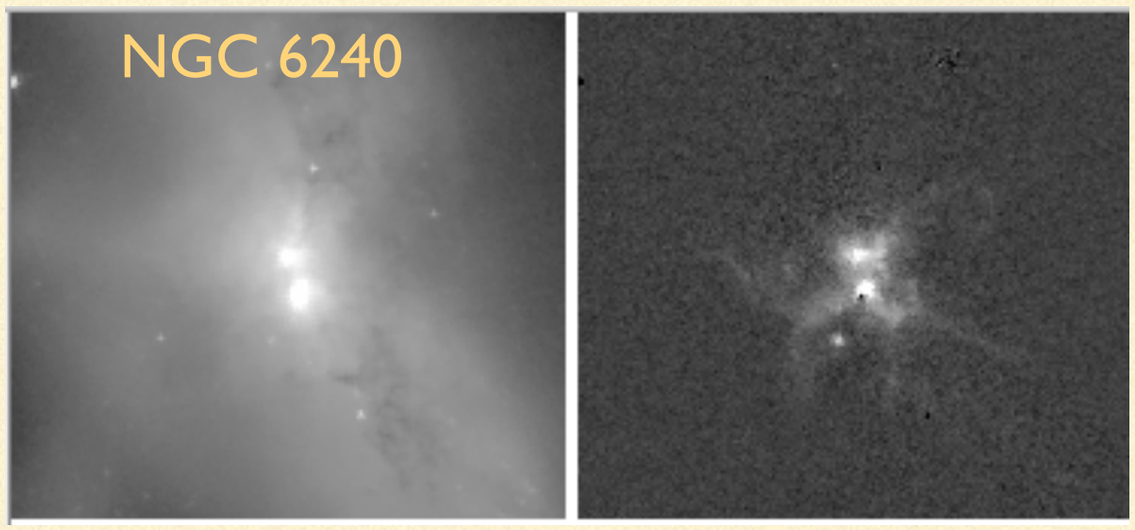
F110W

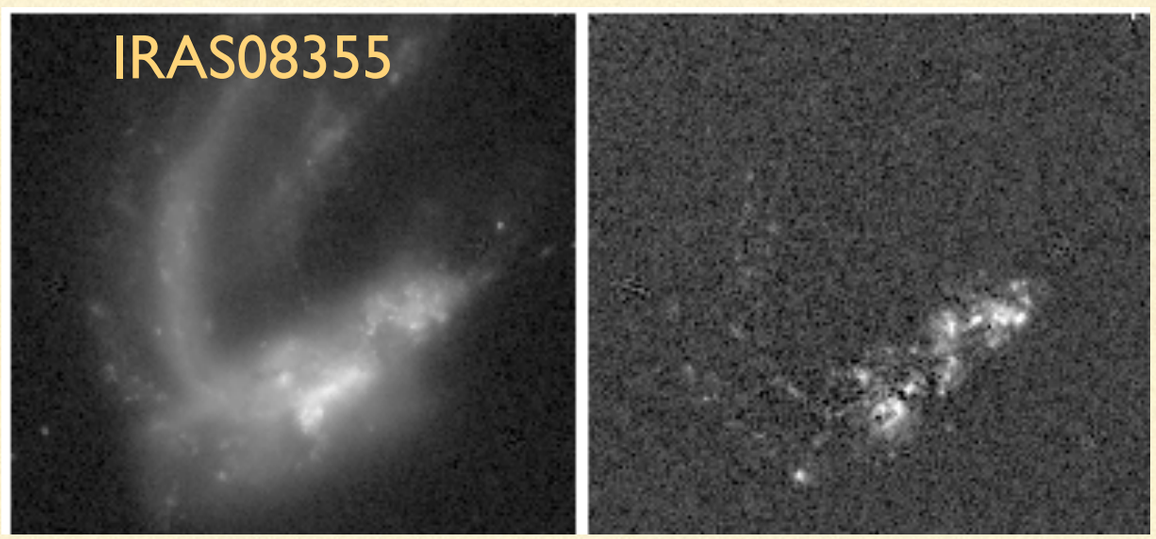
Paβ

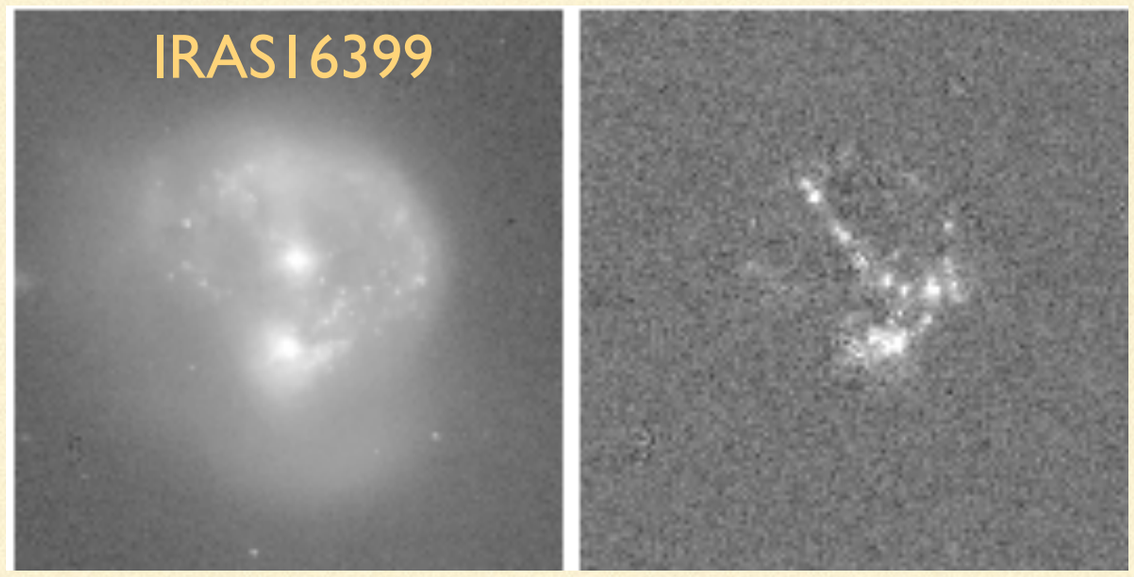


F110W

Paβ

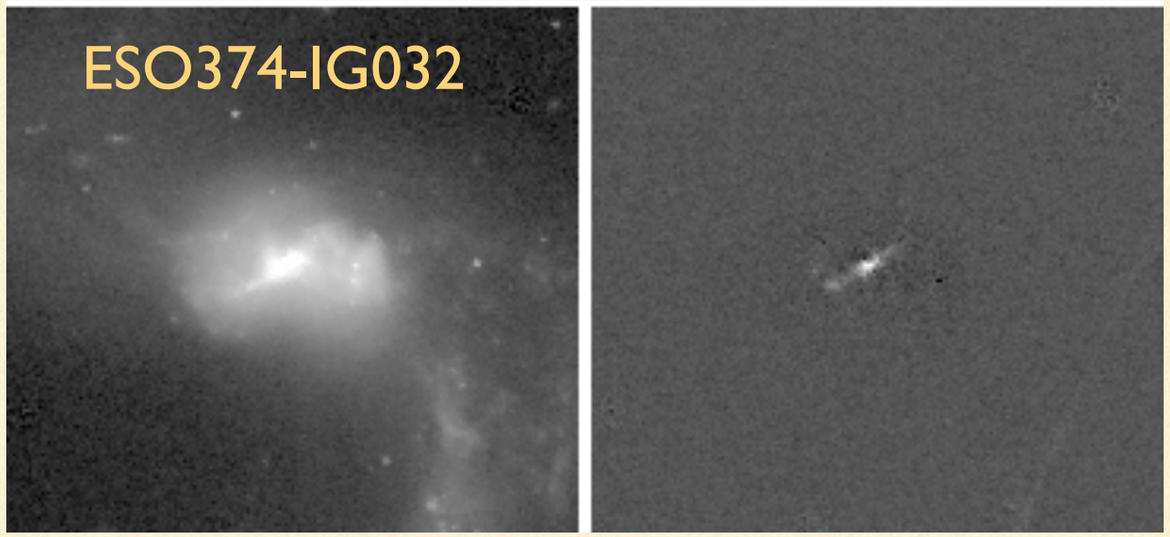


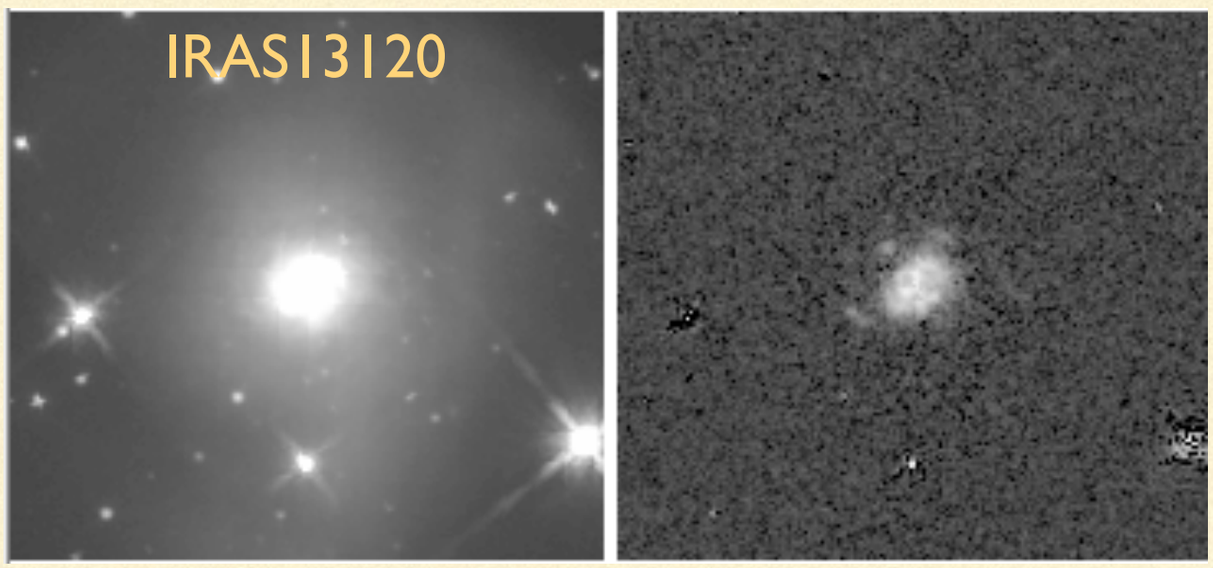


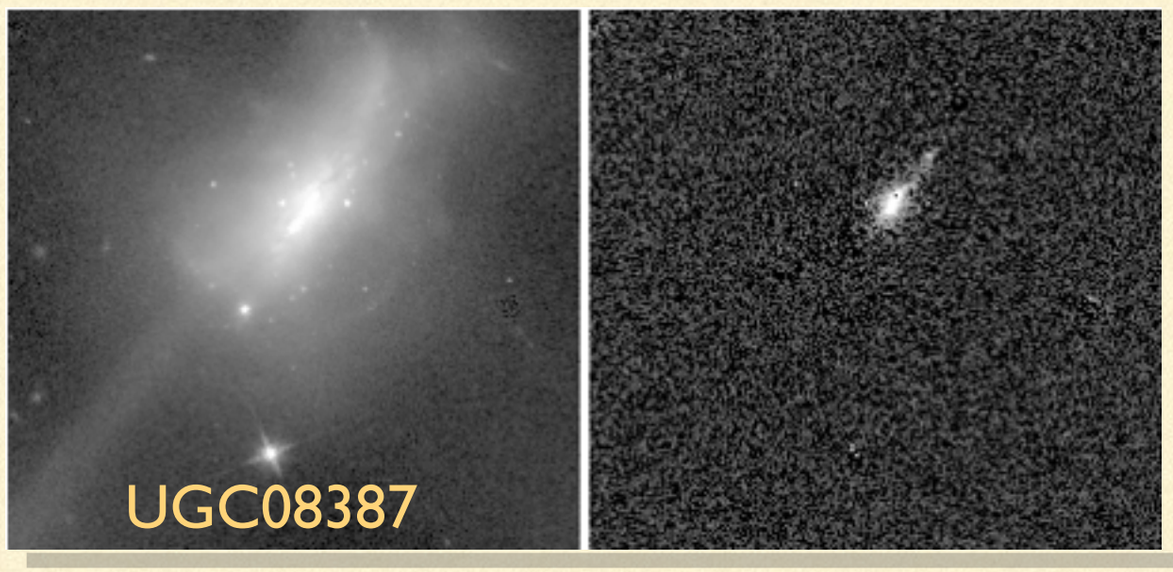


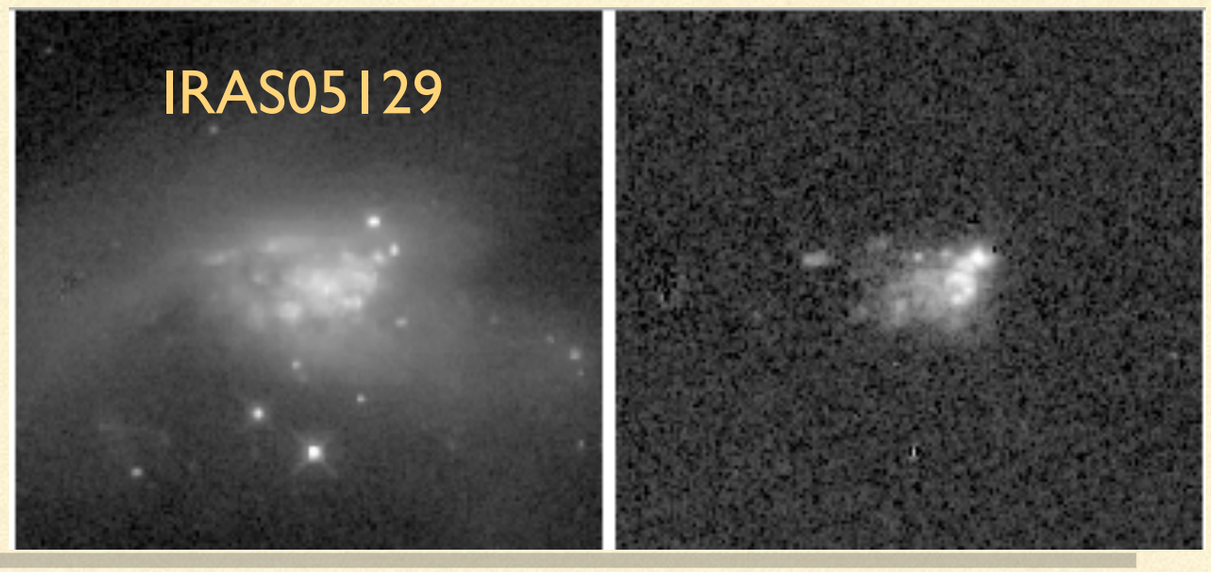
HST Paβ Imaging

F110W Paβ F110W Paβ

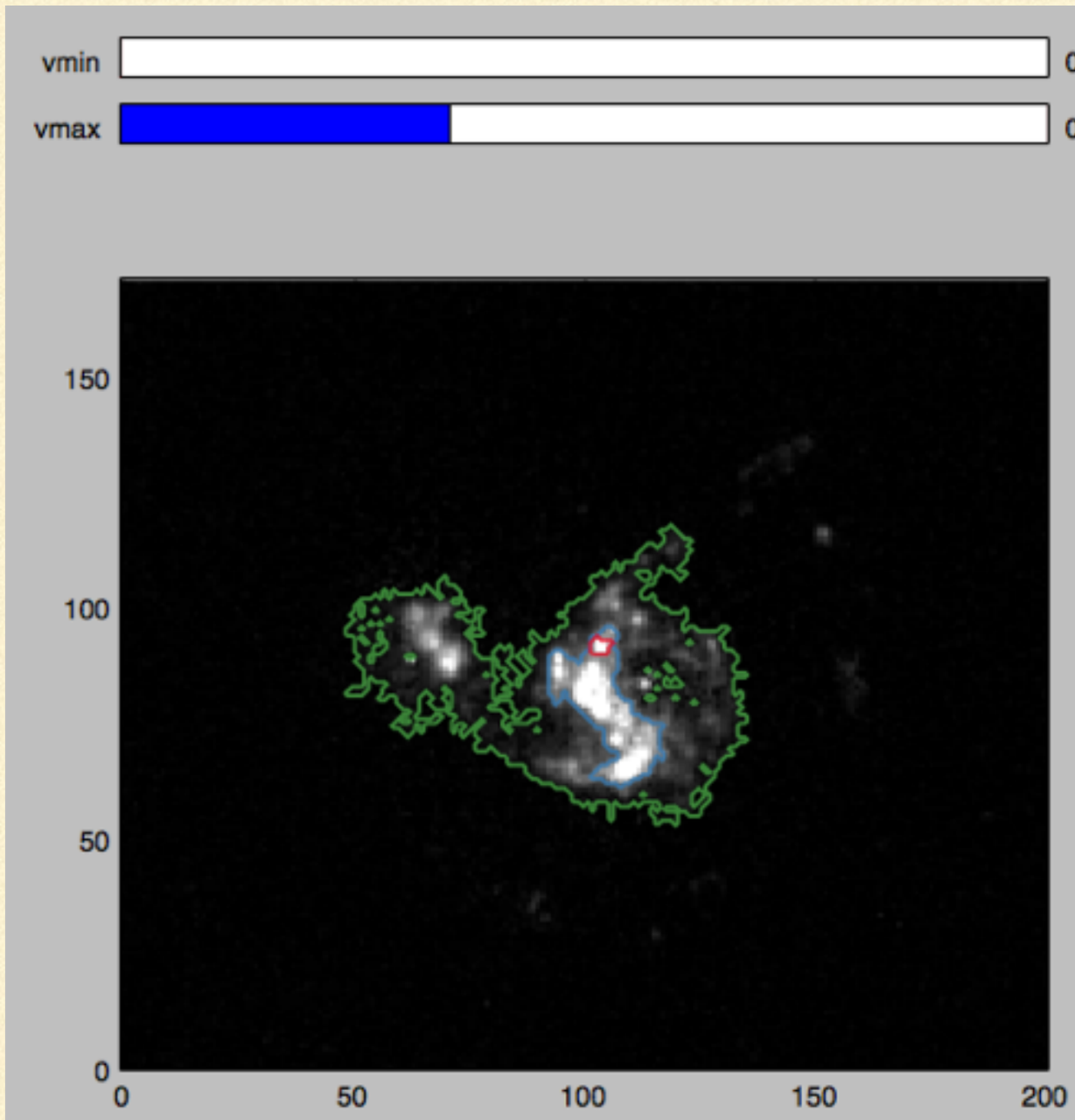


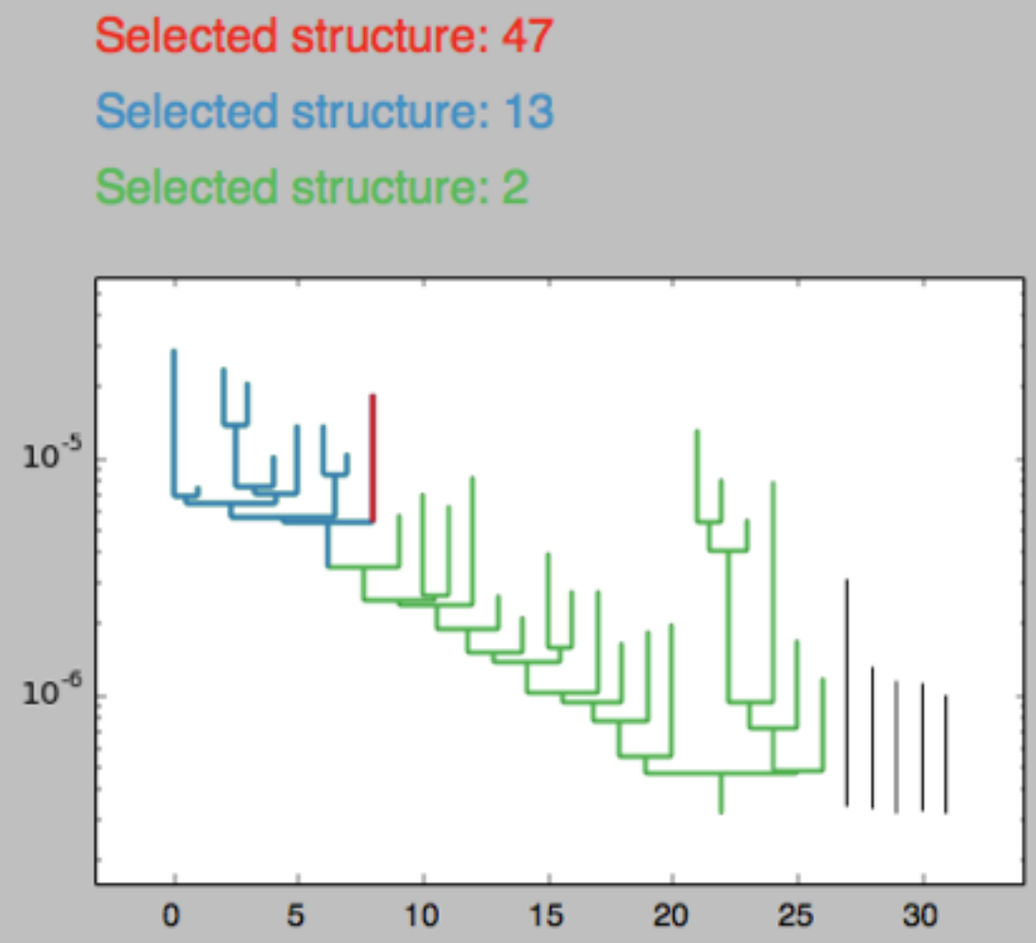




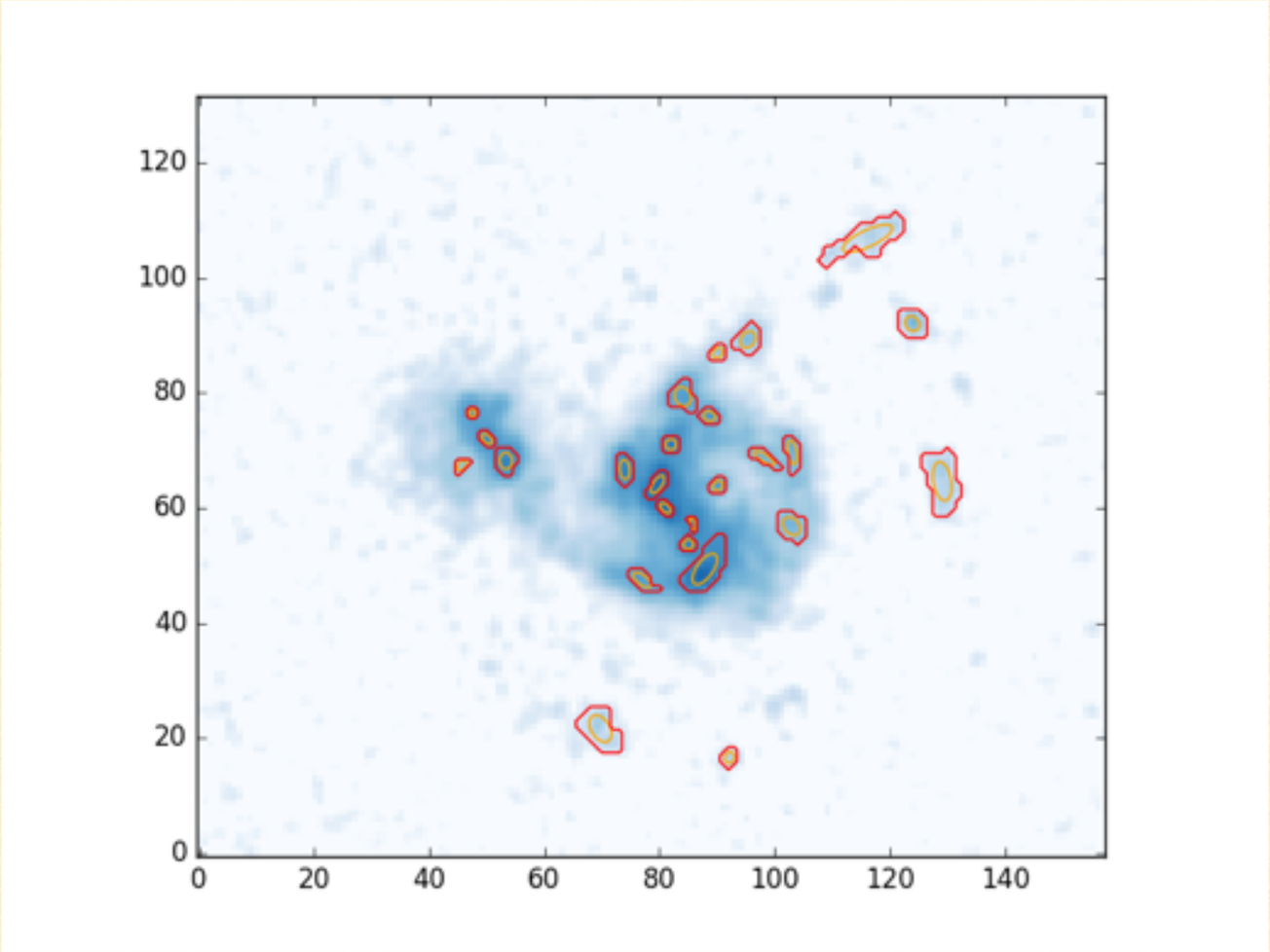


Astrodendro



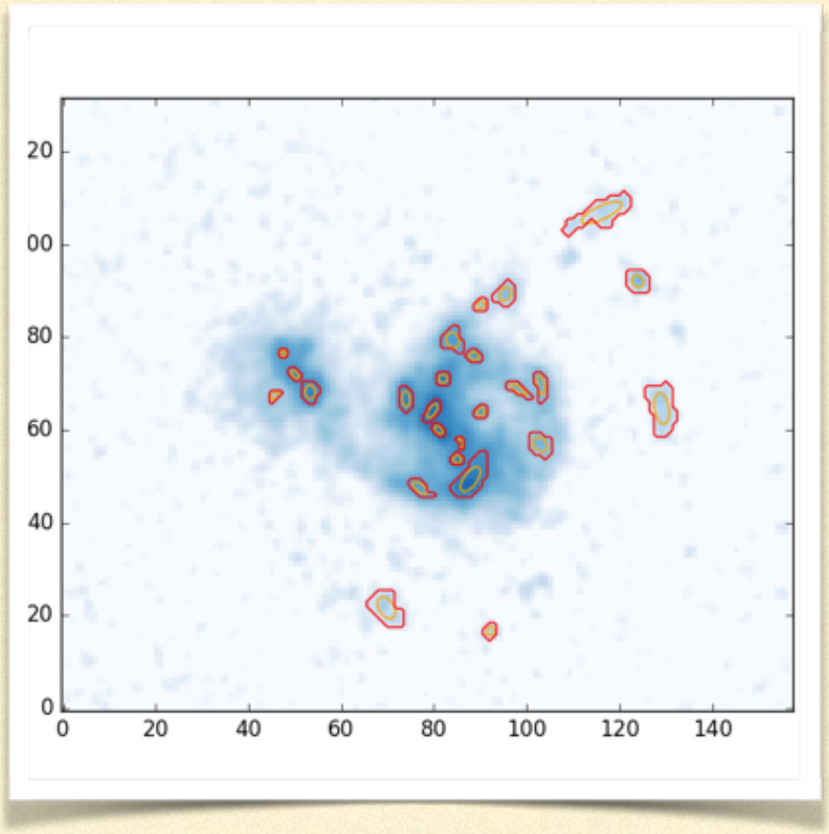


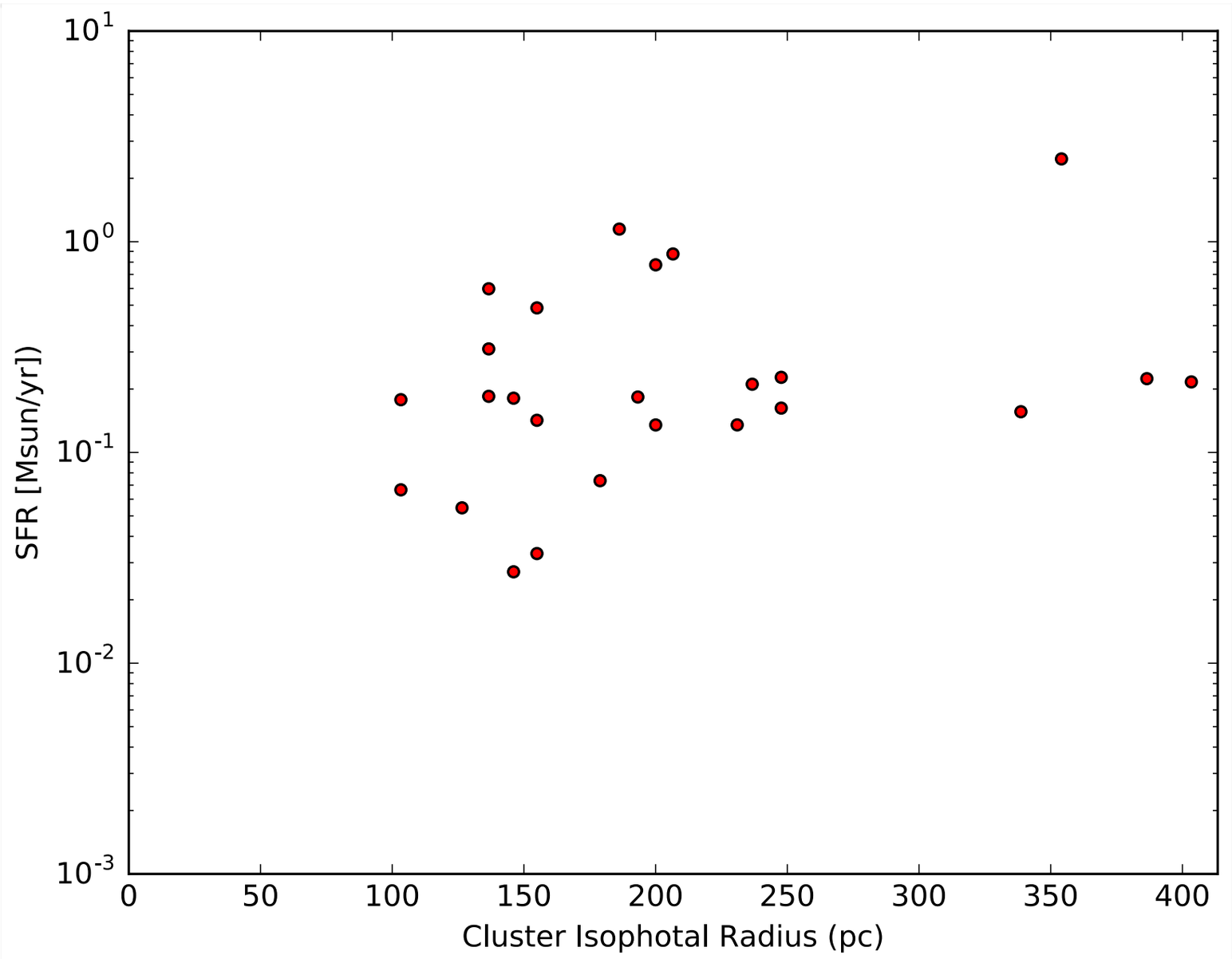
Astrodendro - Clumps

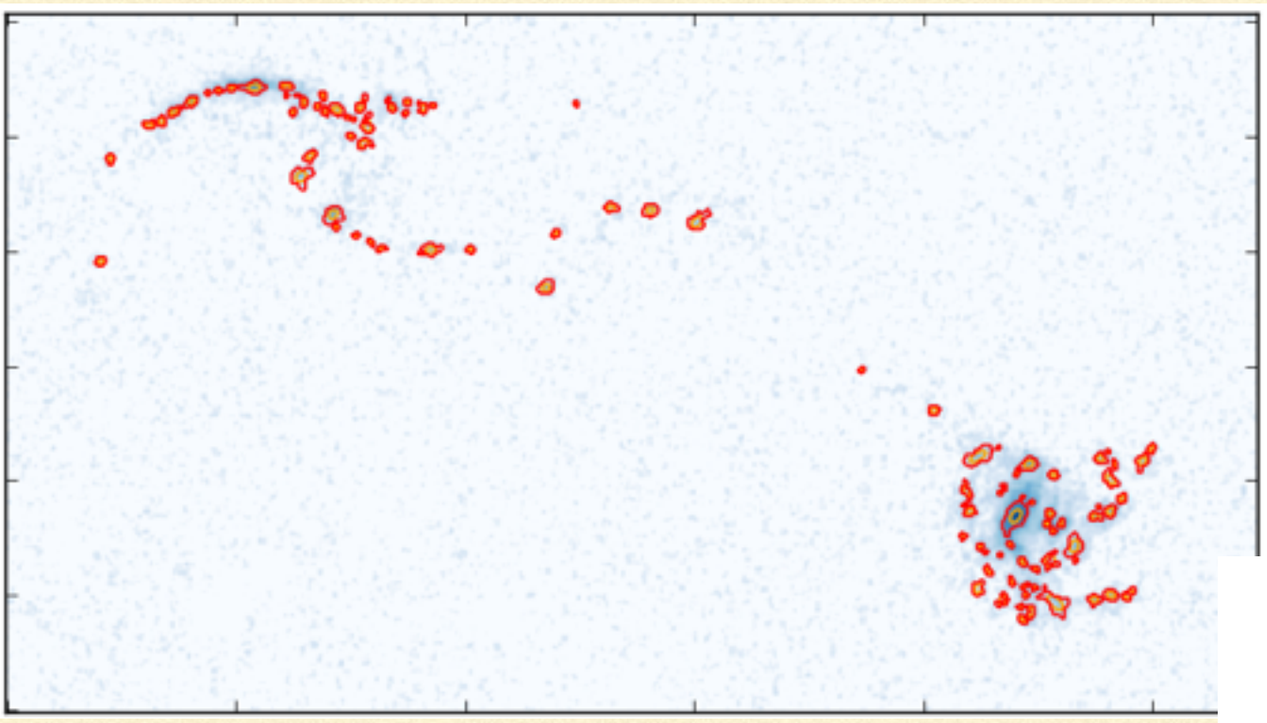


Clump Luminosities and Sizes

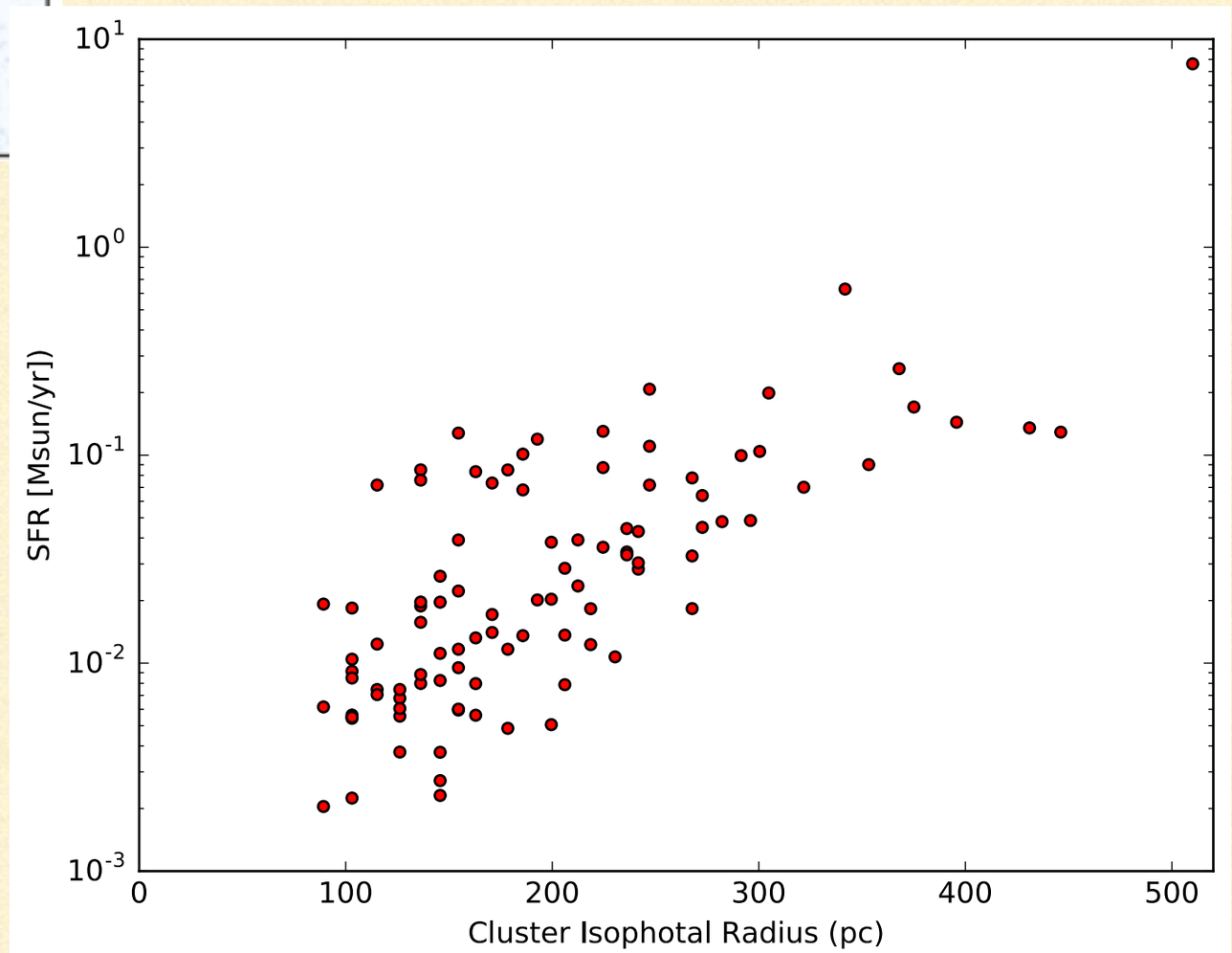
NGC 6090





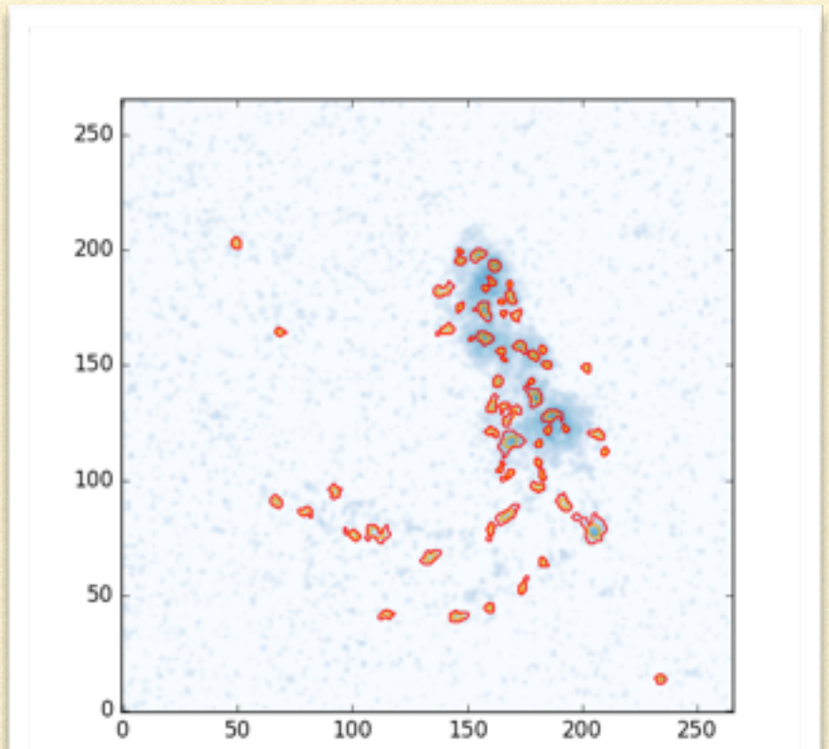


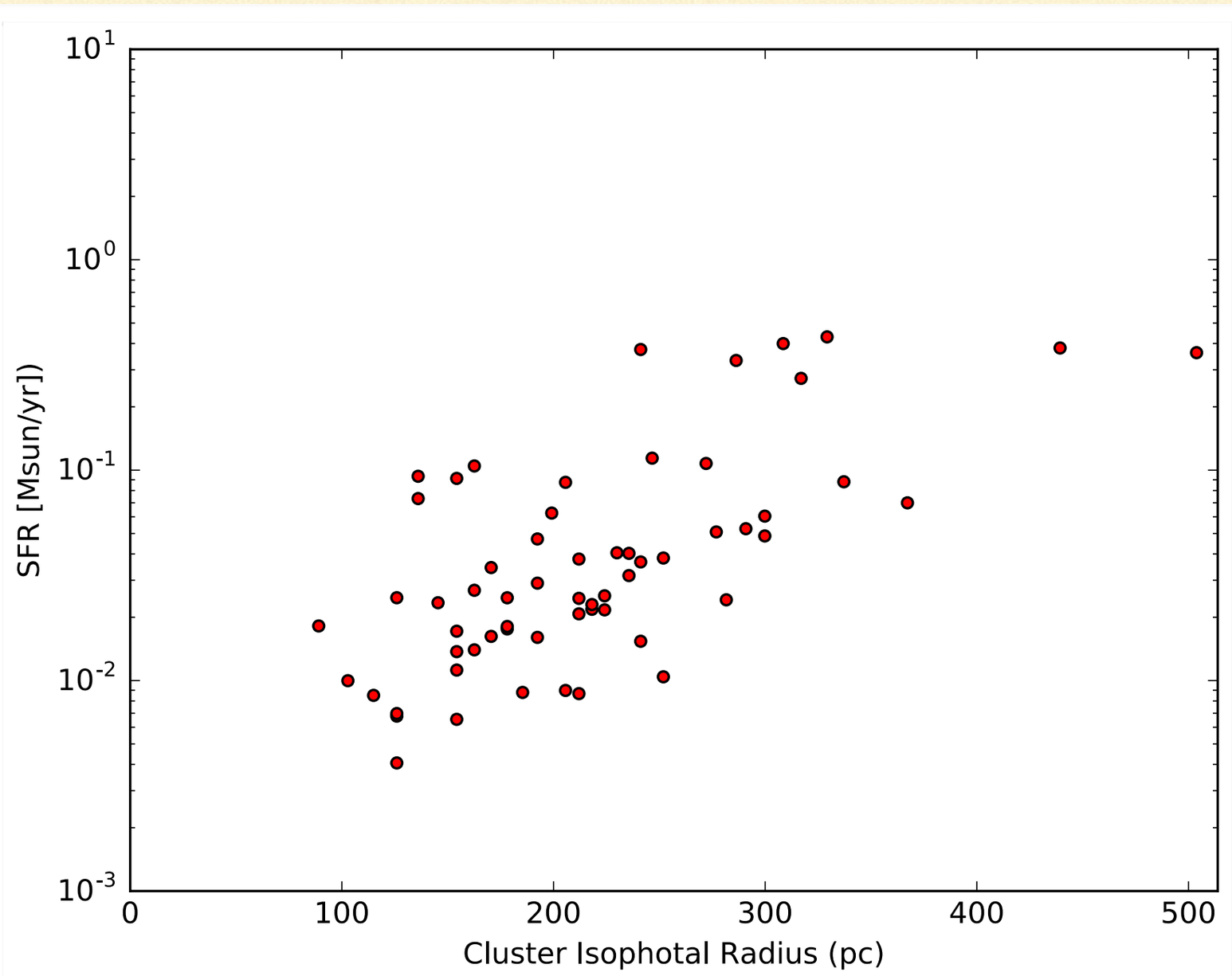
Arp 256


10^1
10^0
10^{-1}
10^{-2}
10^{-3}
SFR [Msun/yr])
0
100
200
300
400
500
Cluster Isophotal Radius (pc)

Clump Luminosities and Sizes

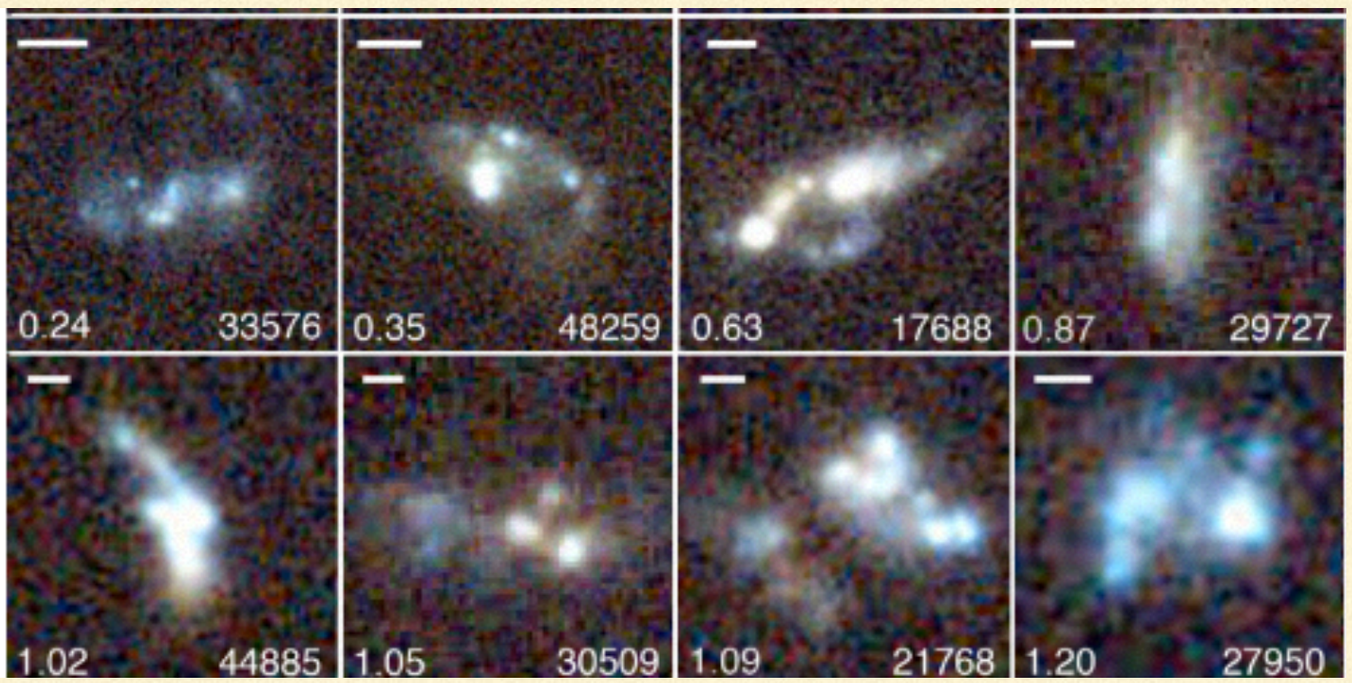
IC 0214





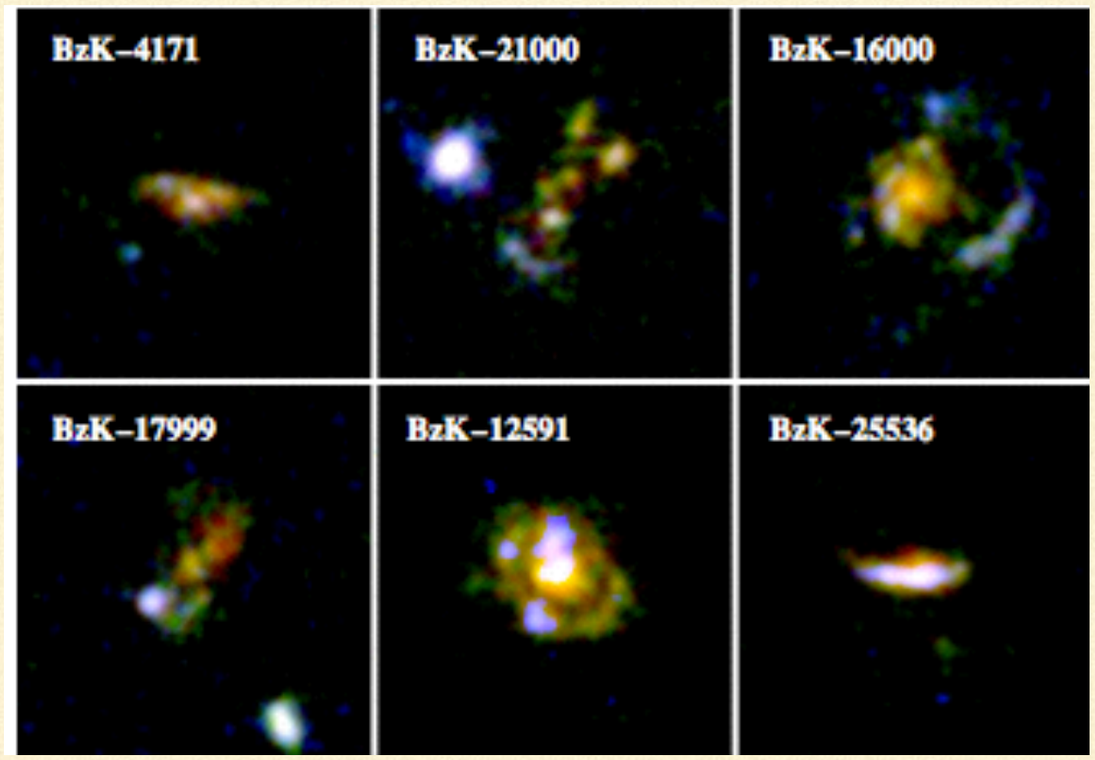
High-z Comparisons

0.2 < z < 1.2



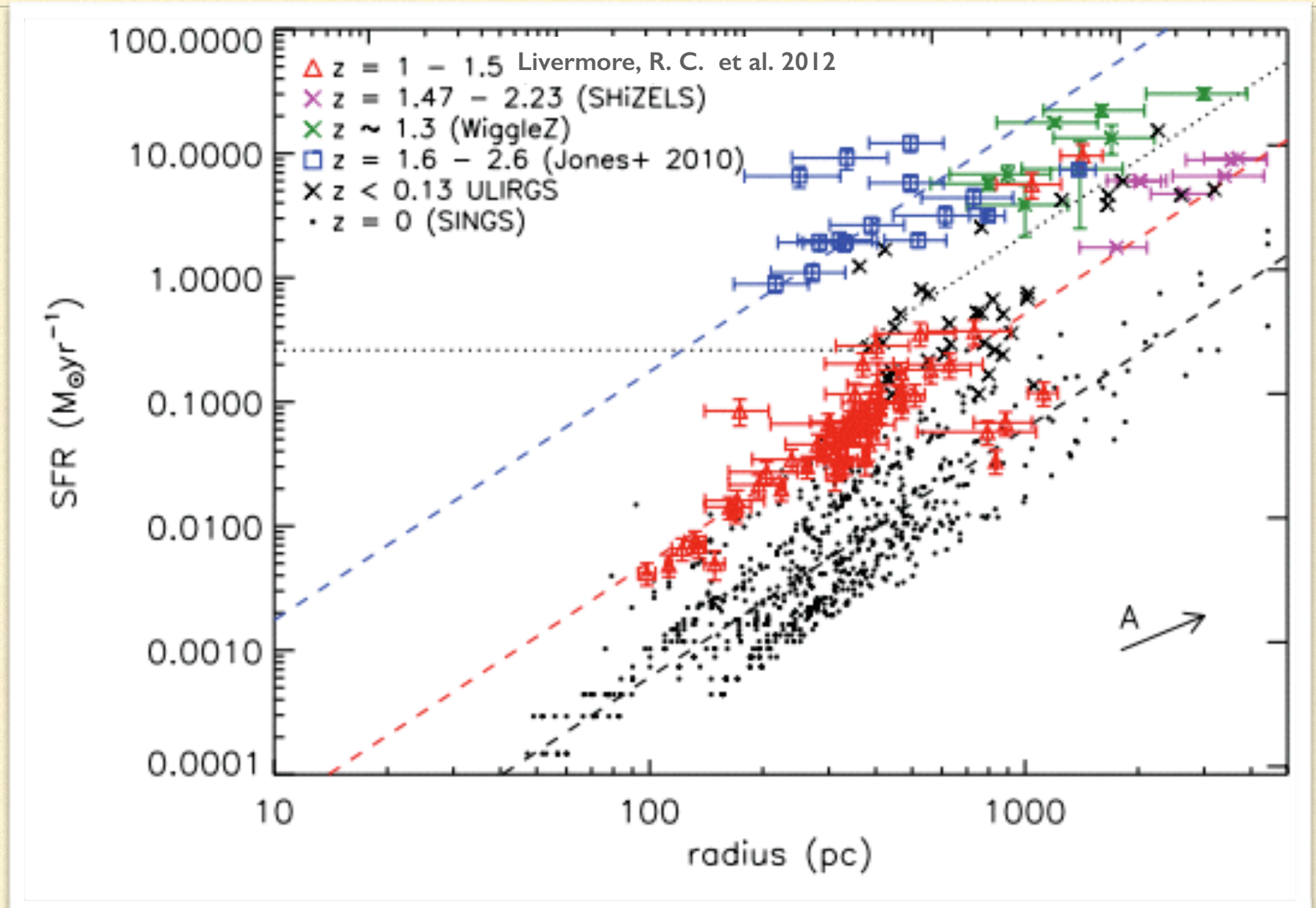
Elmegreen et al. 2009

z ~ 1.5



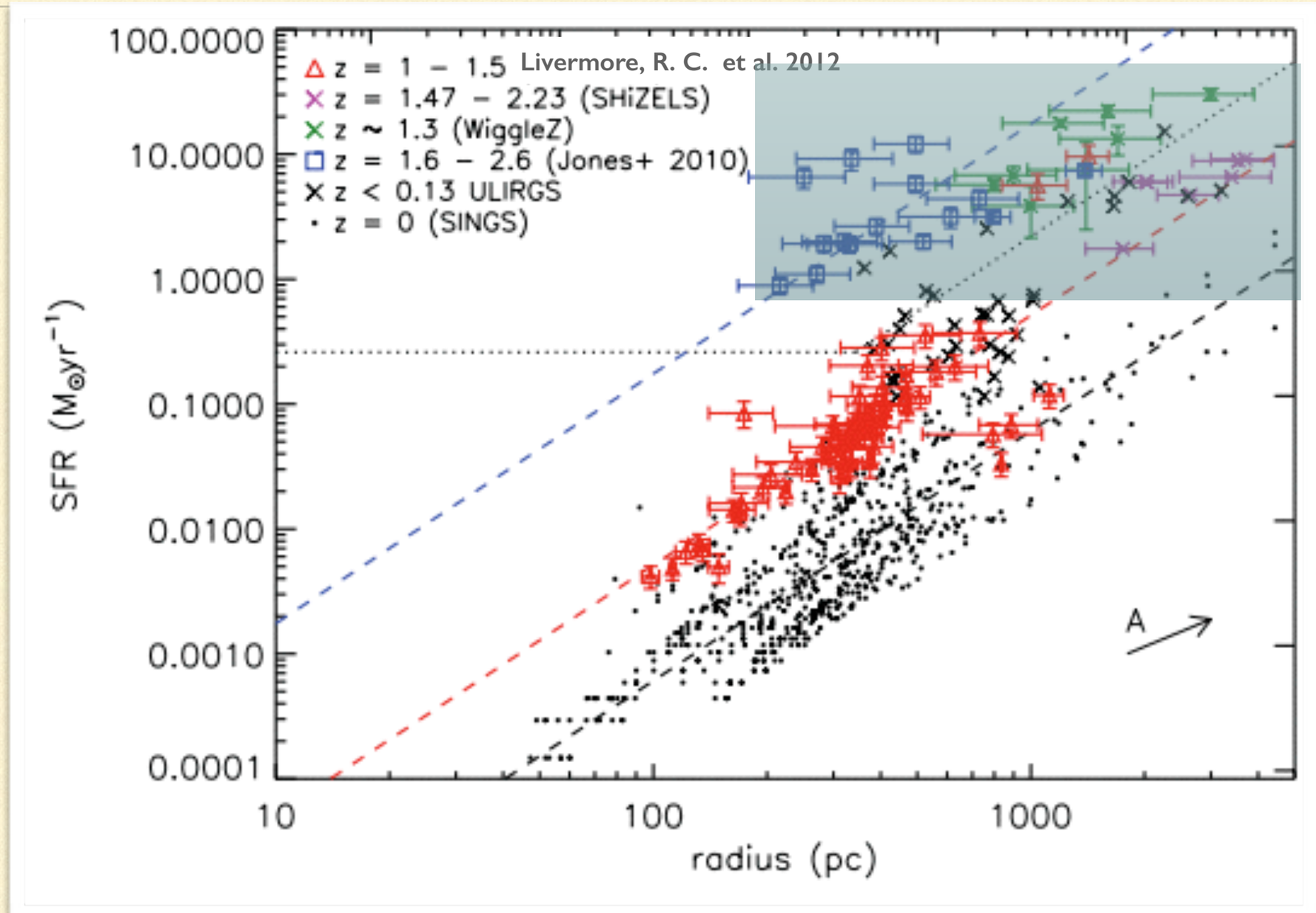
Daddi et al. 2010

High-z Comparisons



Livermore, R. C. et al. 2012

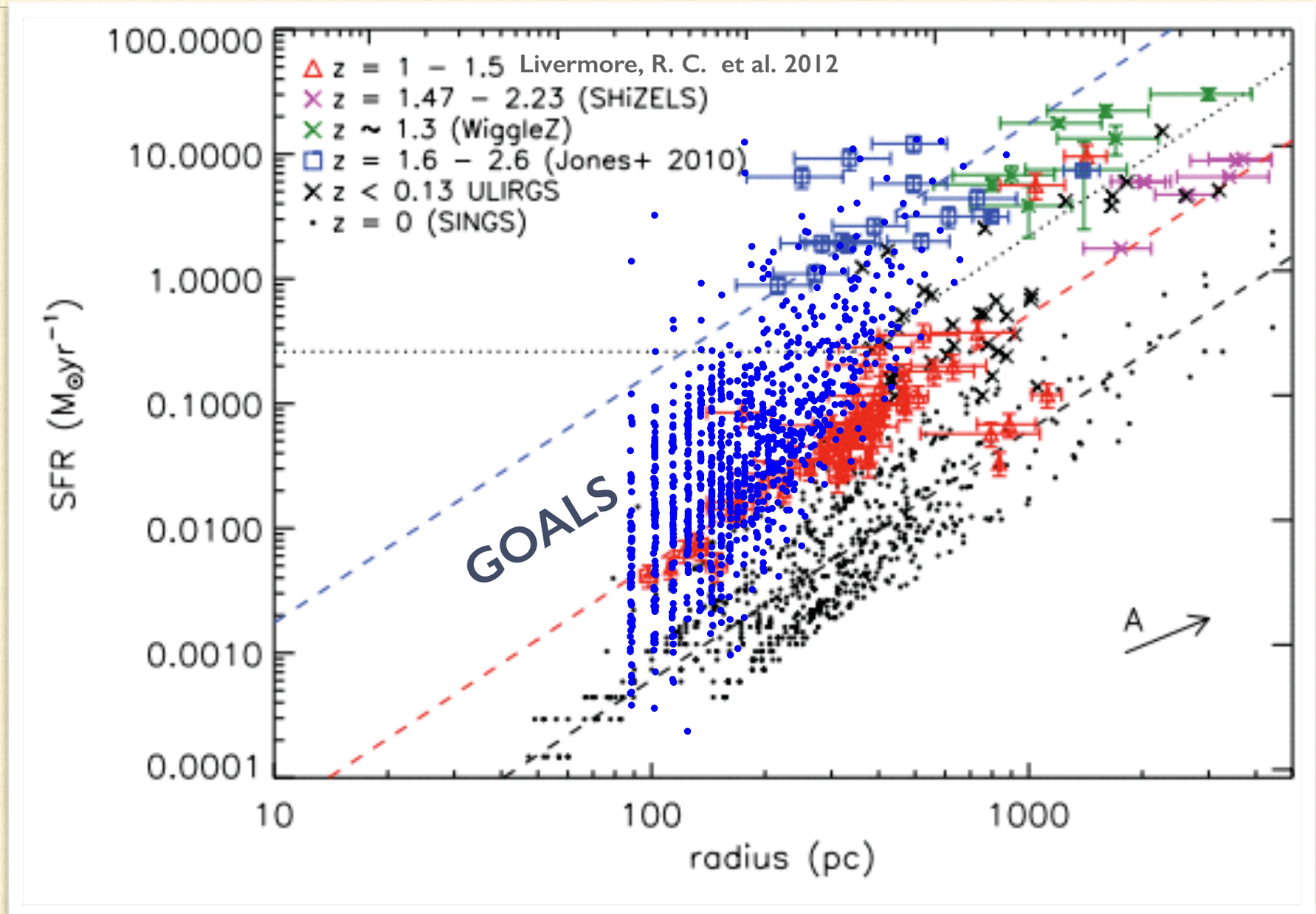
High-z Comparisons



Z
1.5 - 2.5

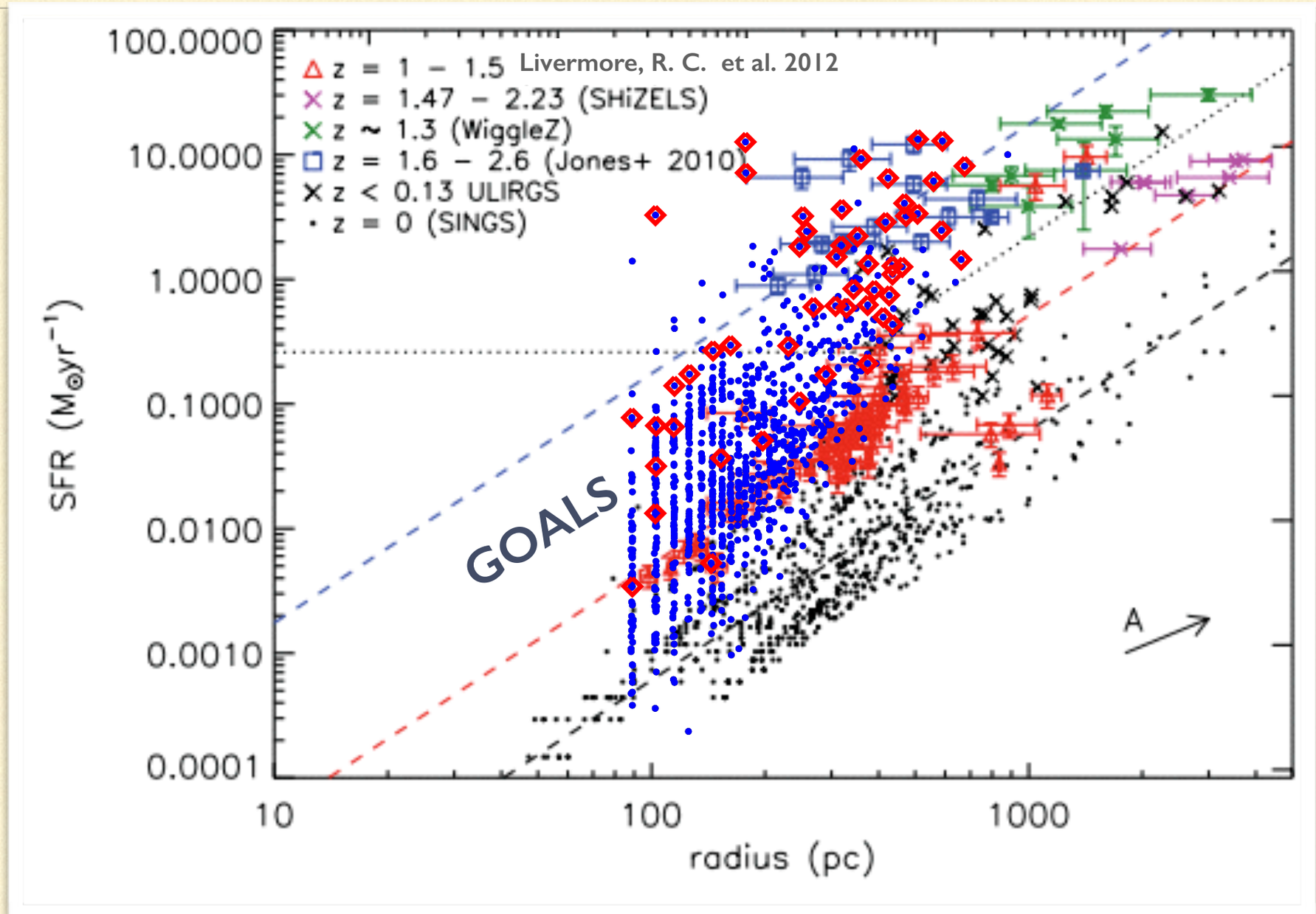
Livermore, R. C. et al. 2012

High-z Comparisons



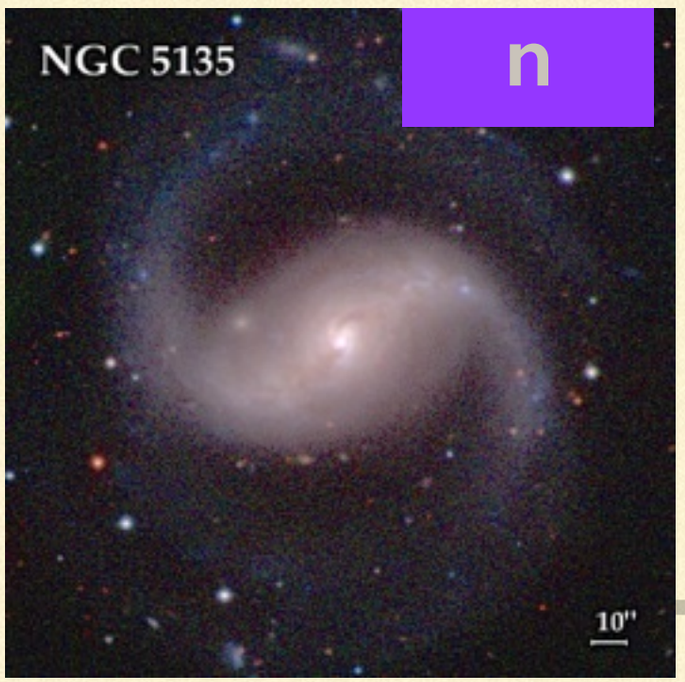
Livermore, R. C. et al. 2012

High-z Comparisons

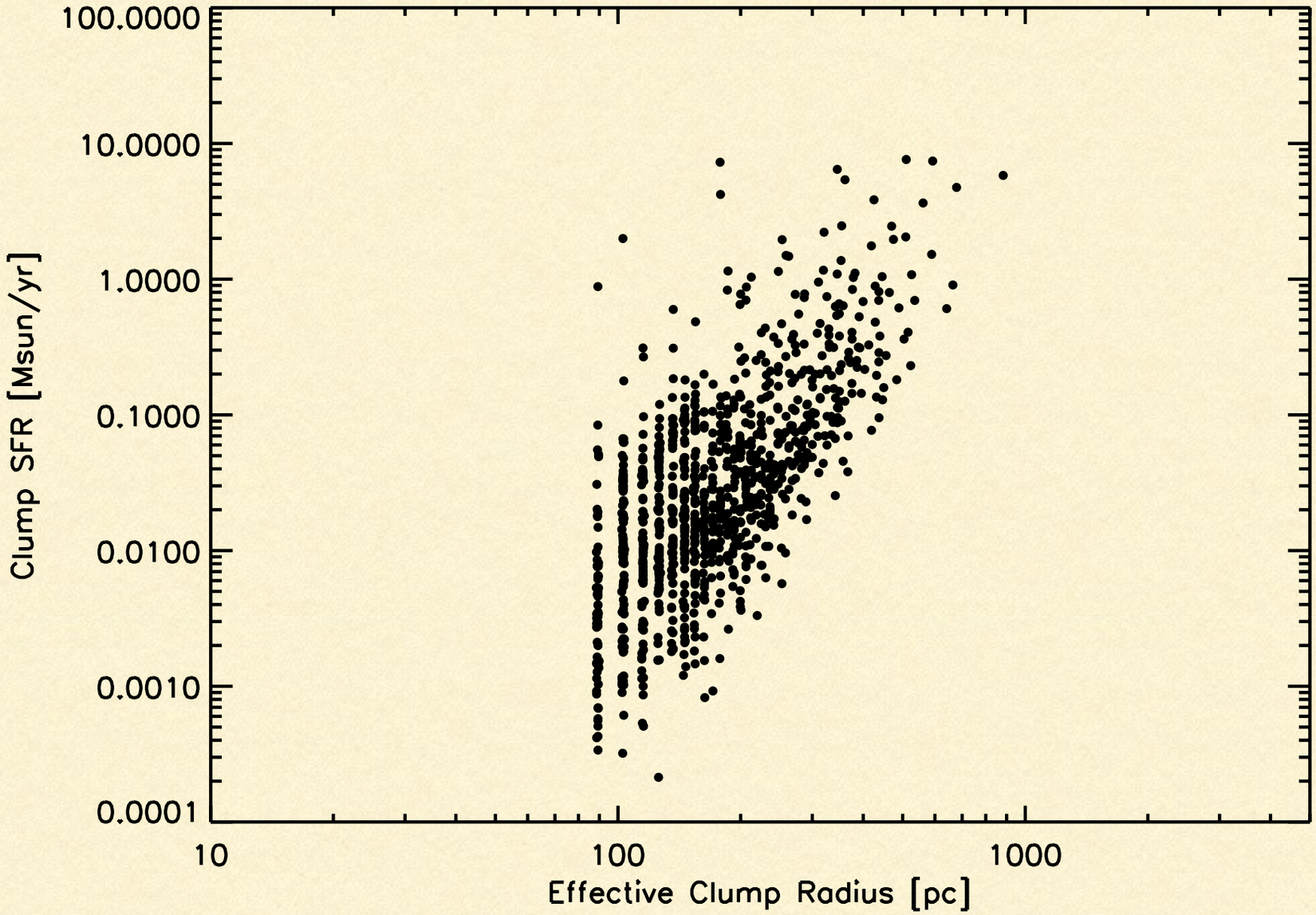


Livermore, R. C. et al. 2012

Merger Stage



Merger Stage



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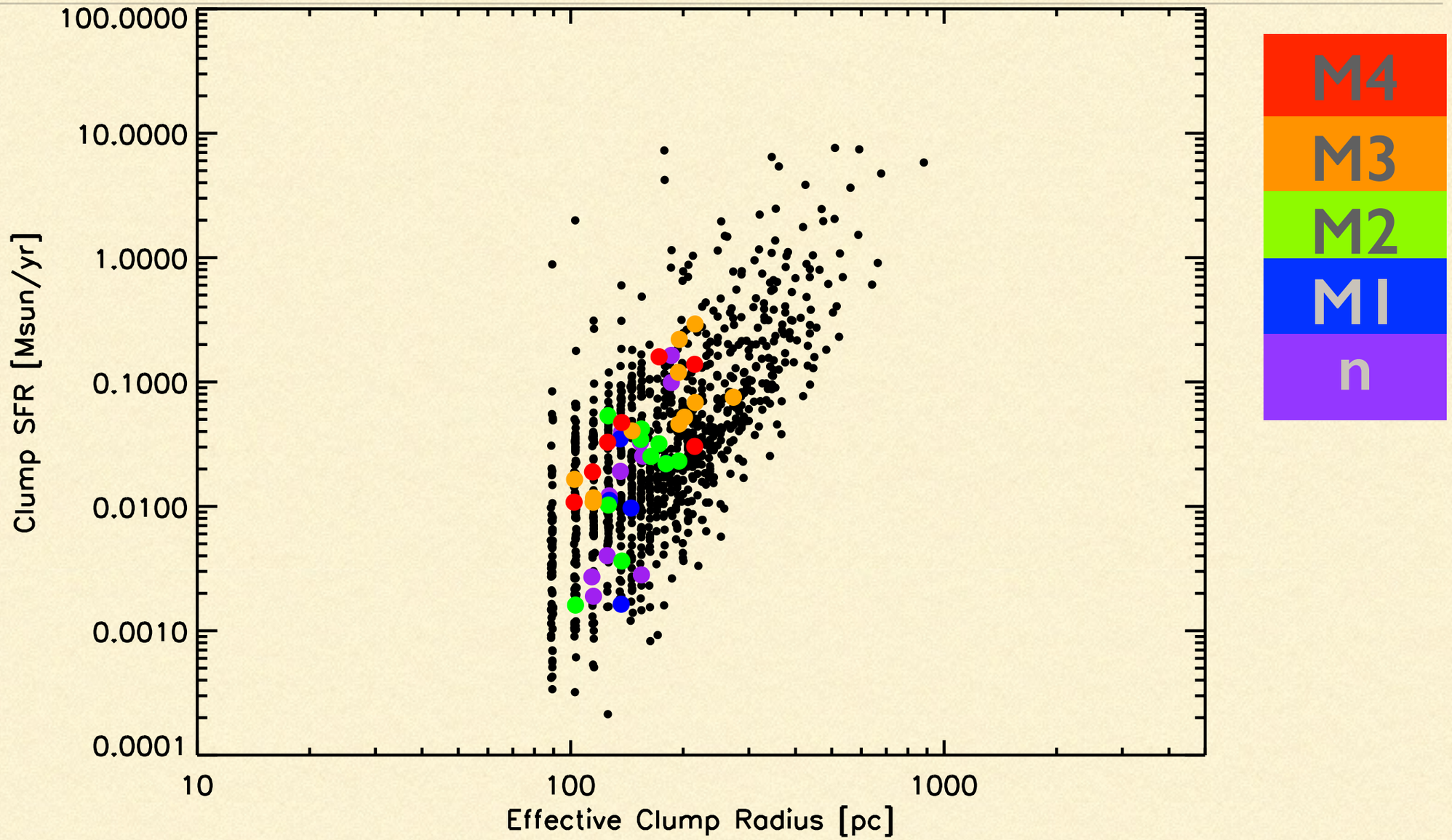
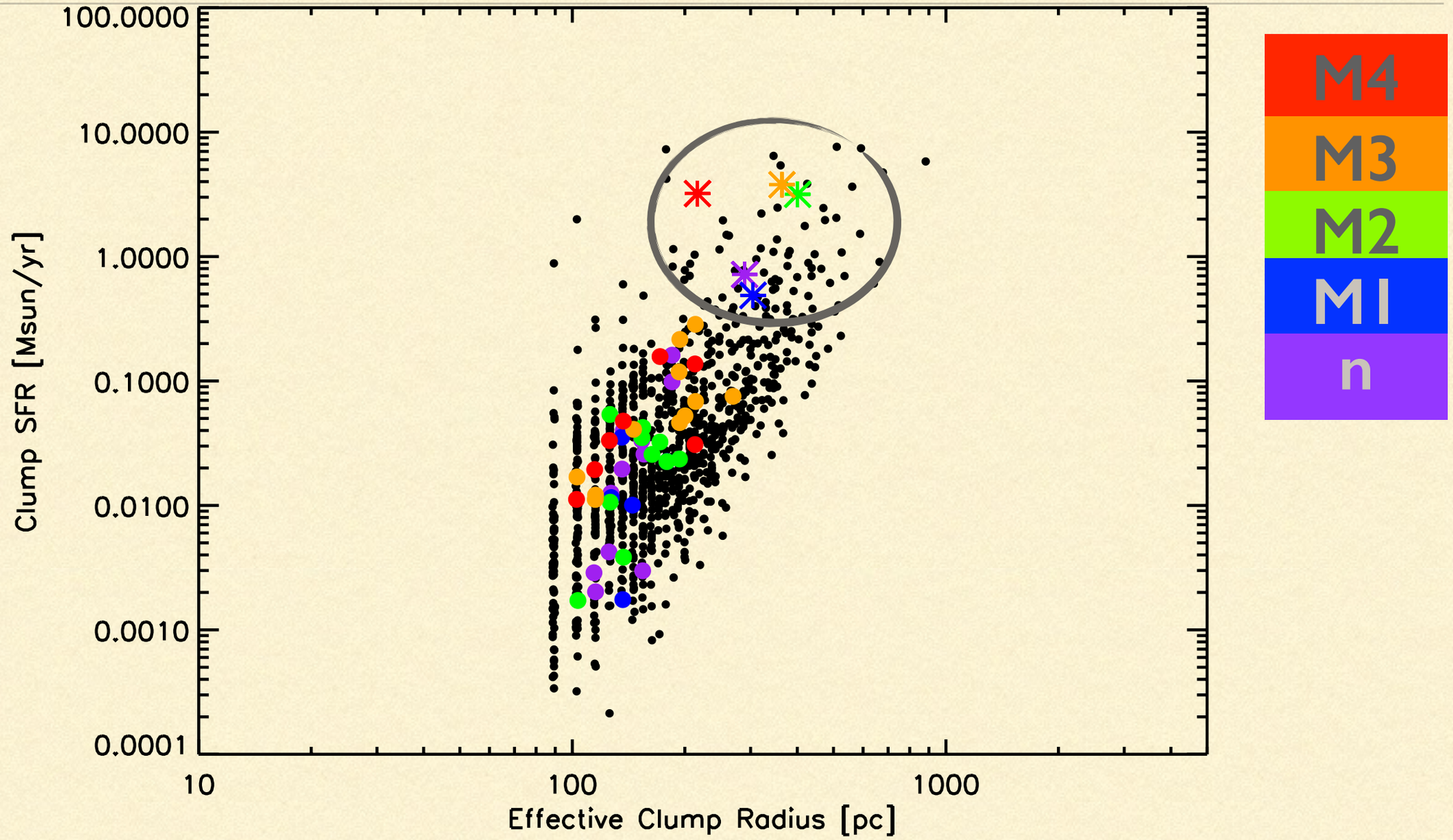
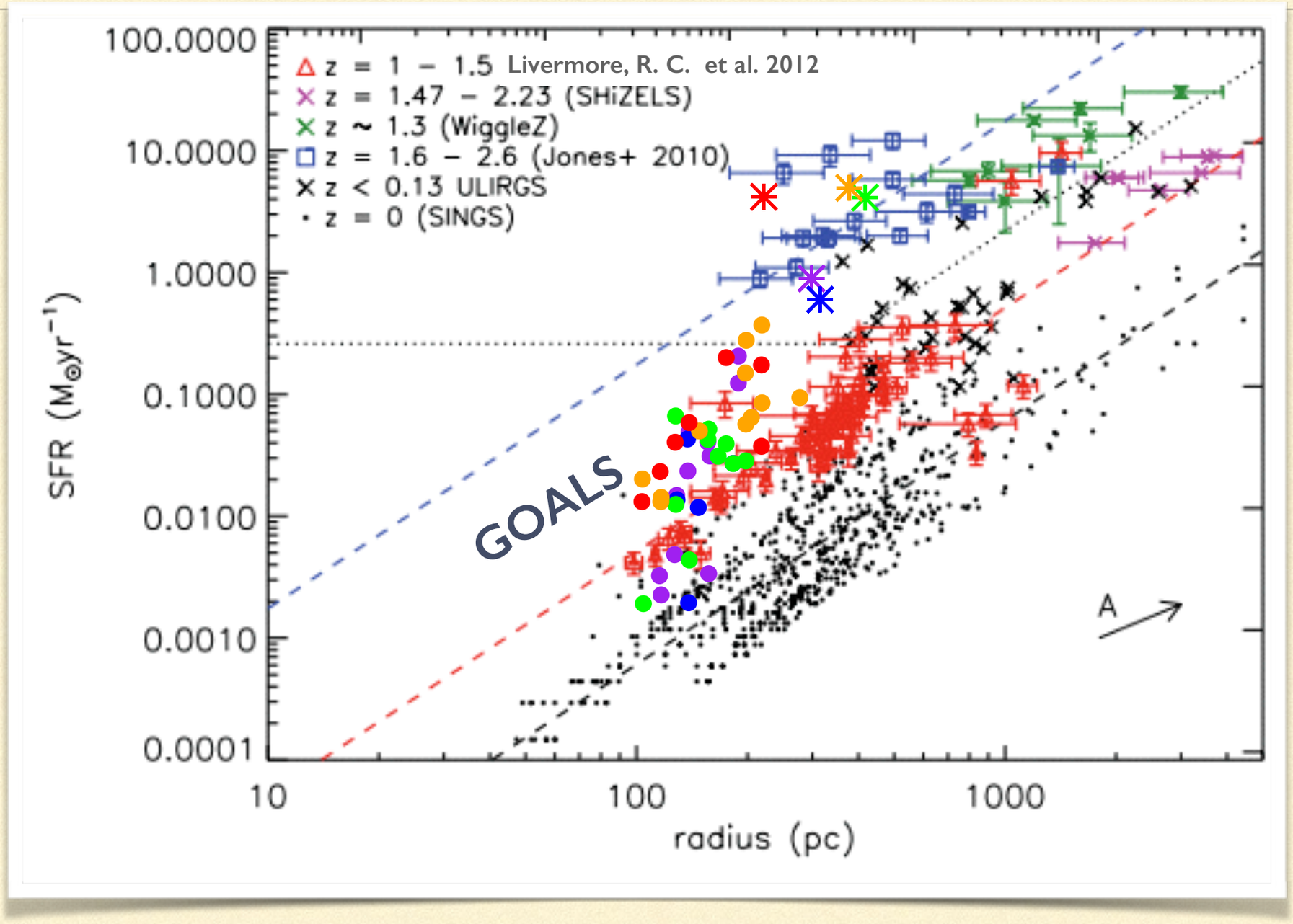
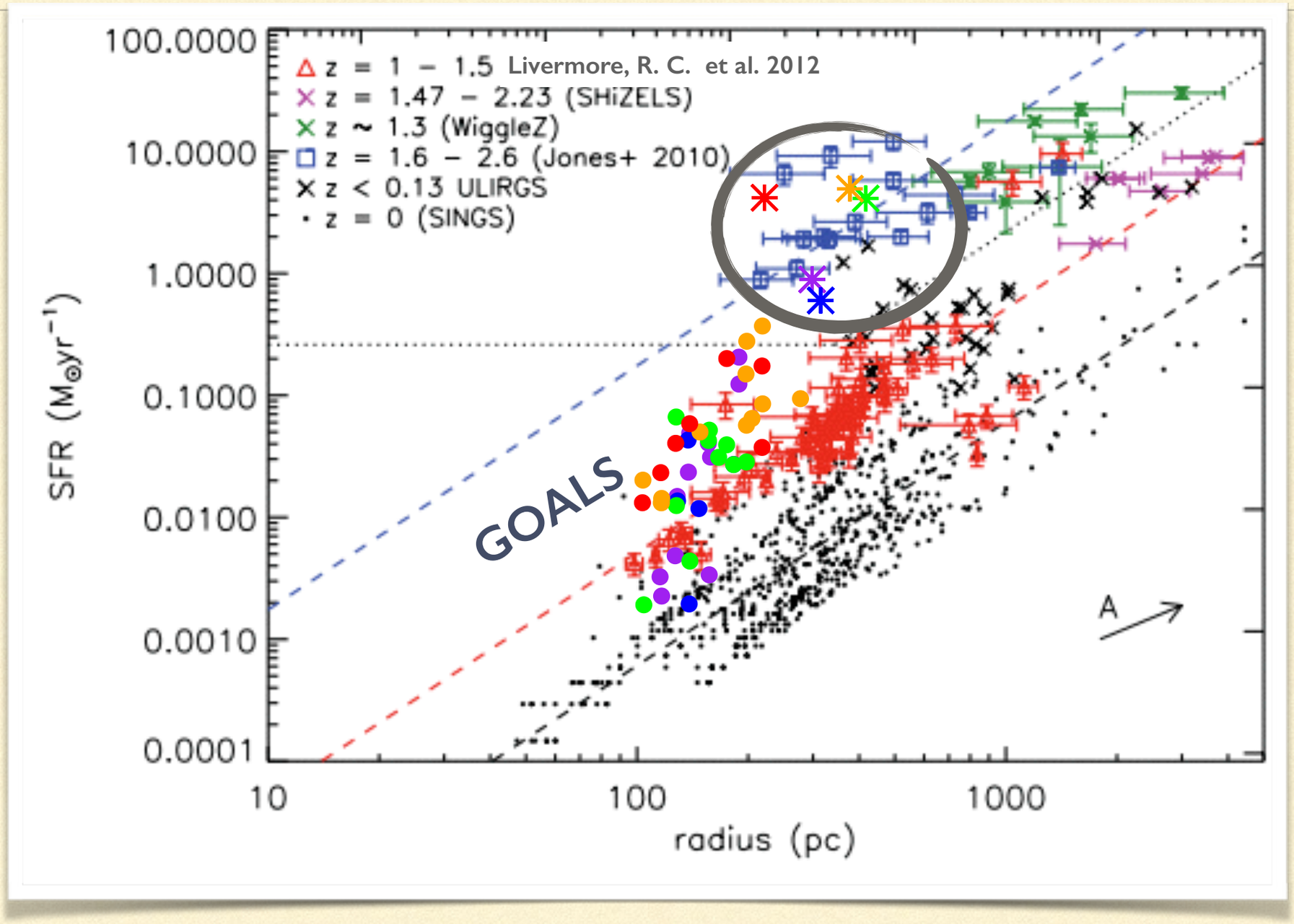


Merger Stage




z = 1 – 1.5 Livermore, R. C. et al. 2012
z = 1.47 – 2.23 (SHiZELS)
z ~ 1.3 (WiggleZ)
z = 1.6 – 2.6 (Jones+ 2010)
z < 0.13 ULIRGS
z = 0 (SINGS)
GOALS
A
100.0000
10.0000
1.0000
0.1000
0.0100
0.0010
0.0001
SFR (M⊙yr⁻¹)
10
100
1000
radius (pc)


100.0000
10.0000
1.0000
0.1000
0.0100
0.0010
0.0001
SFR (M⊙yr⁻¹)
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z < 0.13 ULIRGS
z = 0 (SINGS)
GOALS
A

Summary

- Paβ and Paα HST imaging allows us to detect current obscured star formation in local LIRGS
- Find resolved clumpy star formation of sizes down to <100pc
  - clumps in spiral arms of galaxy pairs
  - few clumps and centrally concentrated star formation in late stage mergers
- Sizes and Luminosites of the clumps span the range between local normal galaxies and high-z galaxies
- Nuclear star formation in LIRGS comparable in SFR to high-z star-forming clumps