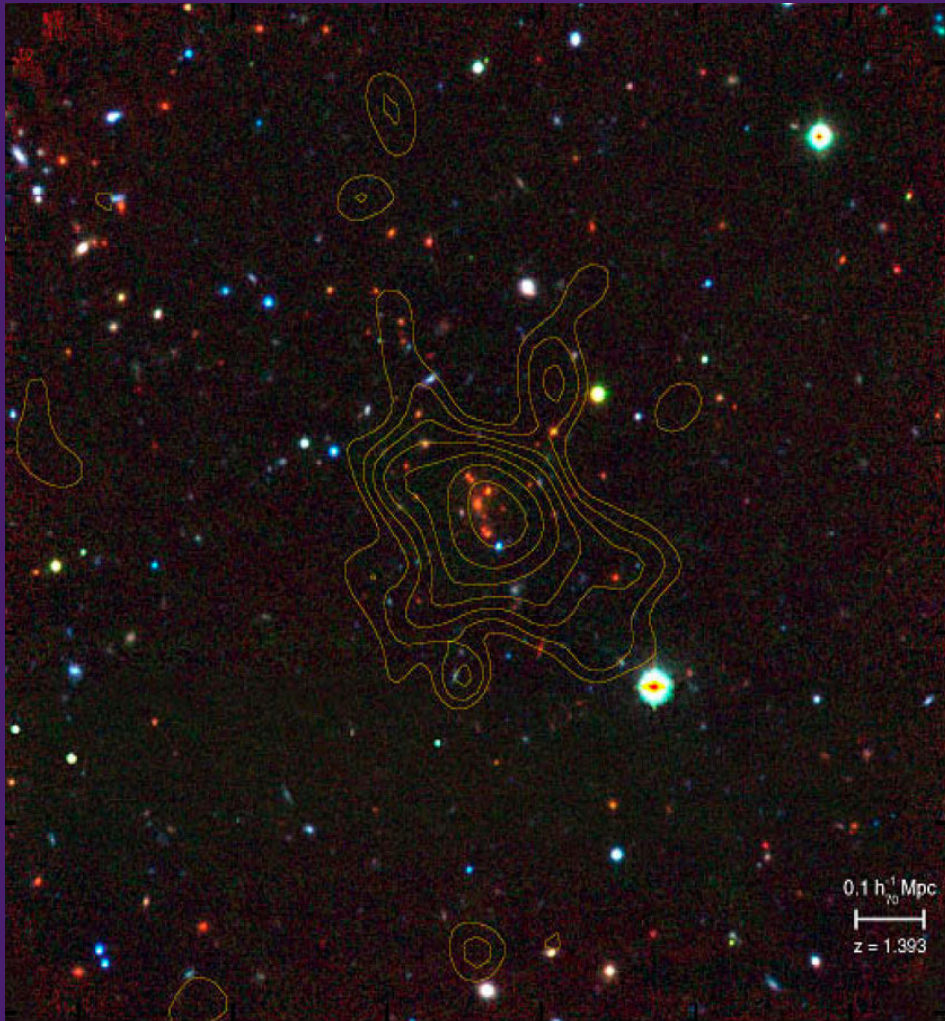


# The early effect of environment on star-formation in XMMU J2235.3-2557

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# A massive evolved cluster at $z=1.4$



VLT ISAAC/FORS2 Ks, z, I band image  
+ XMM-Newton X-ray contours (©eso)

## XMMU J2235.3-2557

- extended X-ray source (Mullis+05)
- tight red sequence (Lidman+08)
- very massive ( $M_{\text{tot}} \sim 6 \times 10^{14} M_{\odot}$ ),  
old stellar populations in cluster  
centre (Rosati+09)
- high mass end of LF already in place  
but smaller sizes (Strazzullo+10)

(One of) the most massive galaxy  
cluster(s) at  $z > 1$

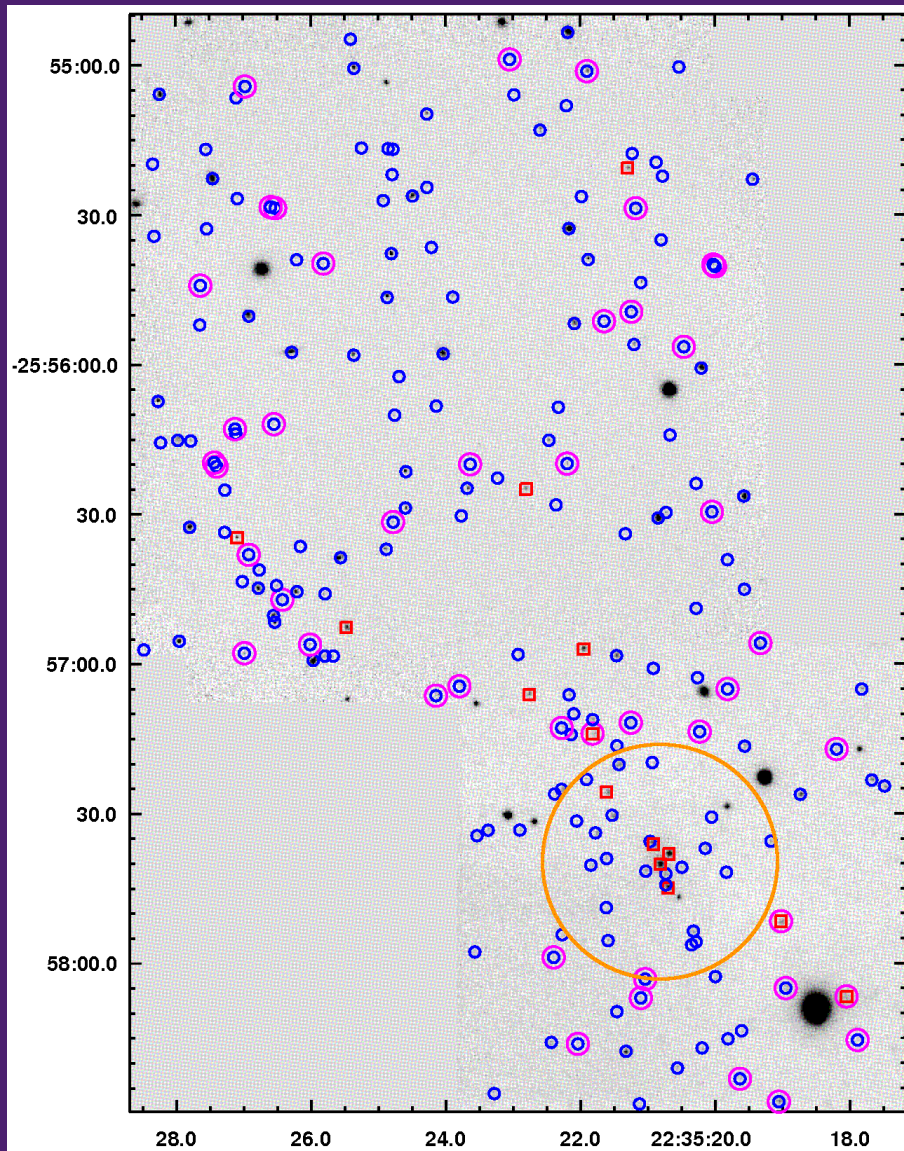
# H-alpha narrow band imaging at $z=1.4$

Direct measure of SFR for individual galaxies?

- NIRI@GEMINI-North: narrow band filter at  $\lambda=1.57\mu\text{m}$   
= H-alpha at  $z=1.39$ !
- 2 pointings:
  - centre ( $R\sim 500\text{kpc}$ ) --> *published in Bauer+11*
  - north-east (out to  $\sim 1.5\text{Mpc}$ ) --> *published in Grützbauch+12*
- Depth:  $H_{\text{broad}} \sim 24.2$ ,  $H_{\text{narrow}} \sim 23.4$  --> limiting SFR  $\sim 5 M_{\odot} \text{yr}^{-1}$
- Identify excess H-alpha emitters:  $3\sigma$  above bg-noise,  $\text{EW} > 20\text{\AA}$
- Identify red sequence galaxies via J-K colours (Lidman+08)  
(+ use to exclude likely stars)

\*\*\* *details in Bauer+11 and Grützbauch+12* \*\*\*

# H-alpha narrow band imaging at $z=1.4$



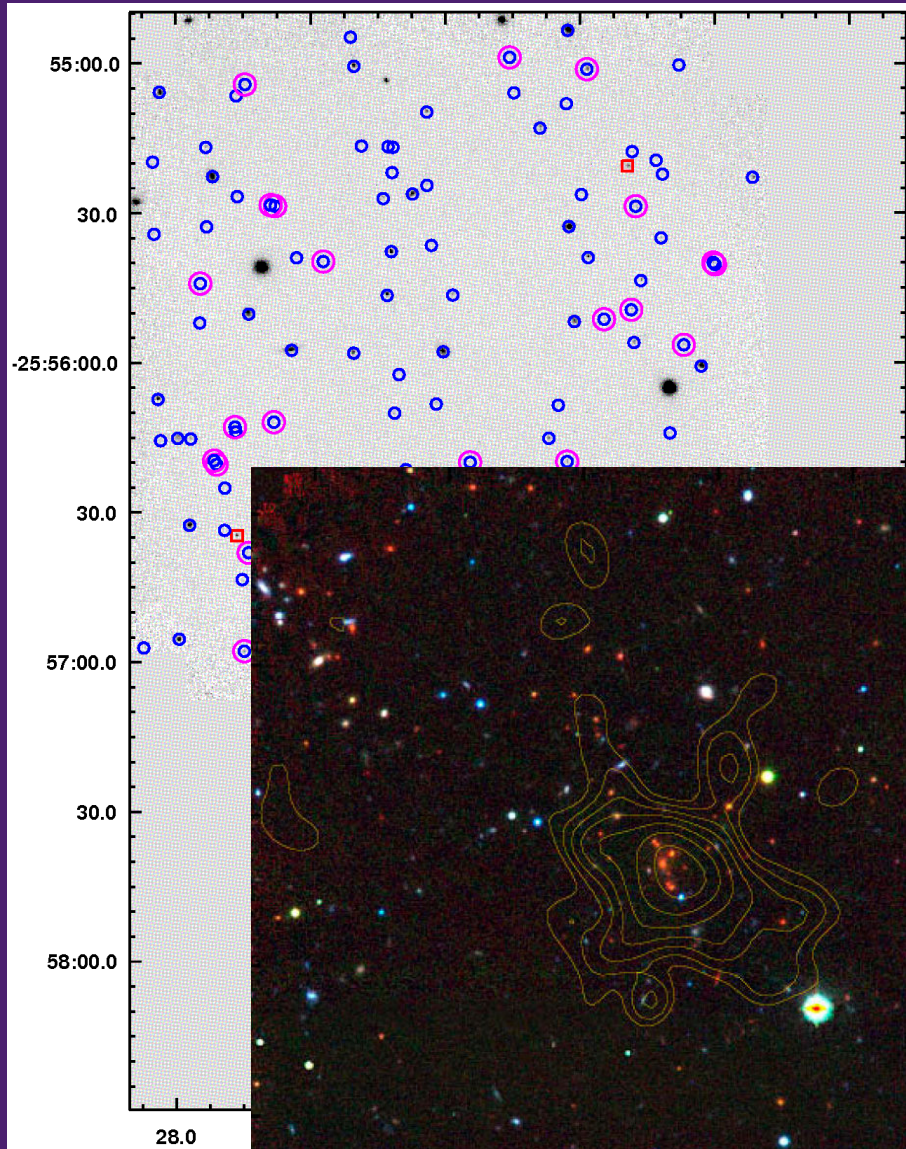
red: confirmed members (14)

blue: all detections (163)

magenta: excess emitters (32)

orange circle:  $R_Q = 200$  kpc

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orange circle:  $R_Q = 200 \text{ kpc}$

# SFR in XMMU 2235

red: confirmed members

magenta circle: H-alpha emitter

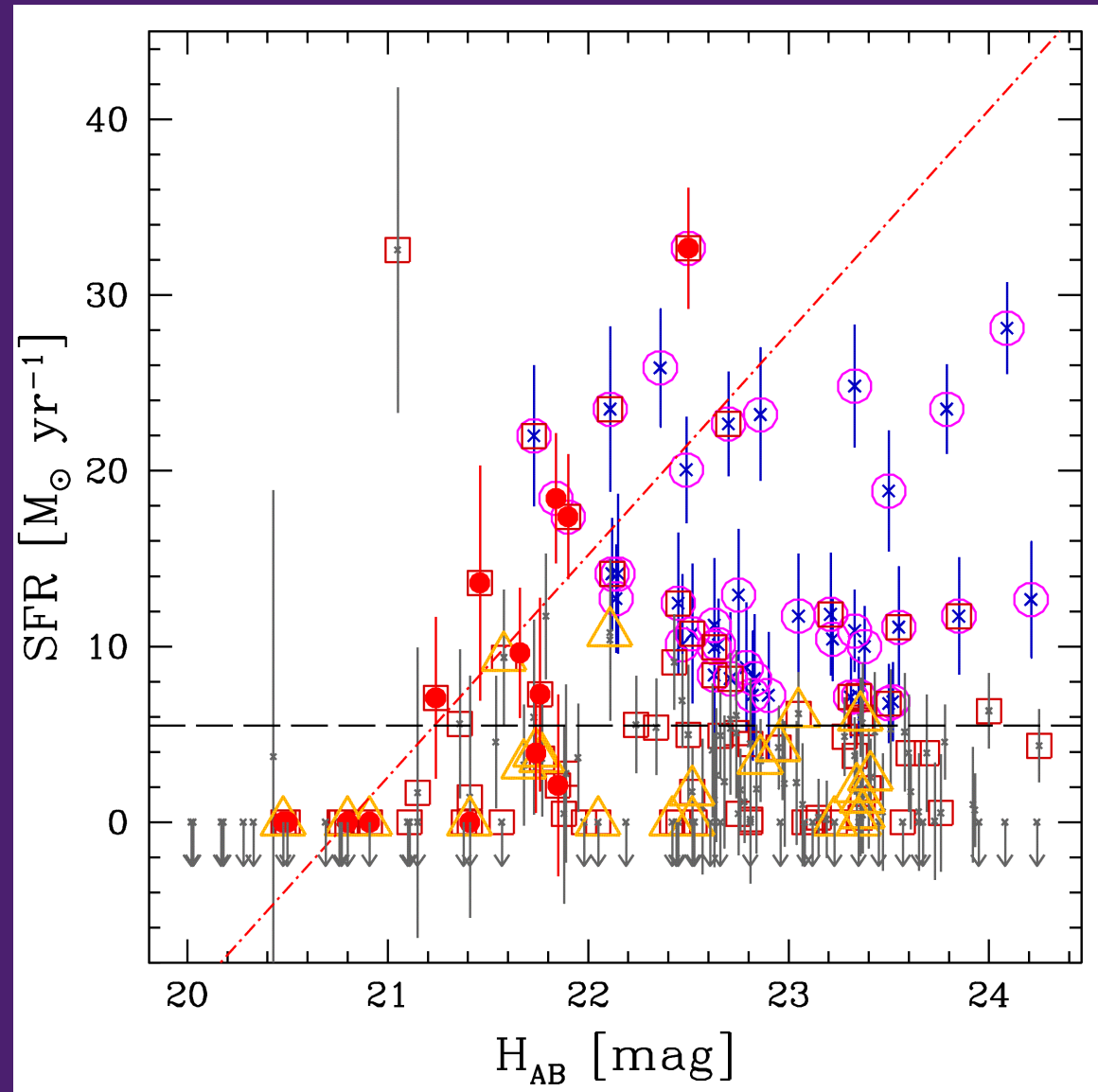
orange triangle: within 200 kpc

**No** H-alpha emitters within a 200 kpc radius of the brightest cluster galaxy.

--> quenching radius  $R_Q$

--> coincides with extension of X-ray emission

*Bauer+11, Grützbauch+12*



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red: confirmed members

magenta circle: H-alpha emitter

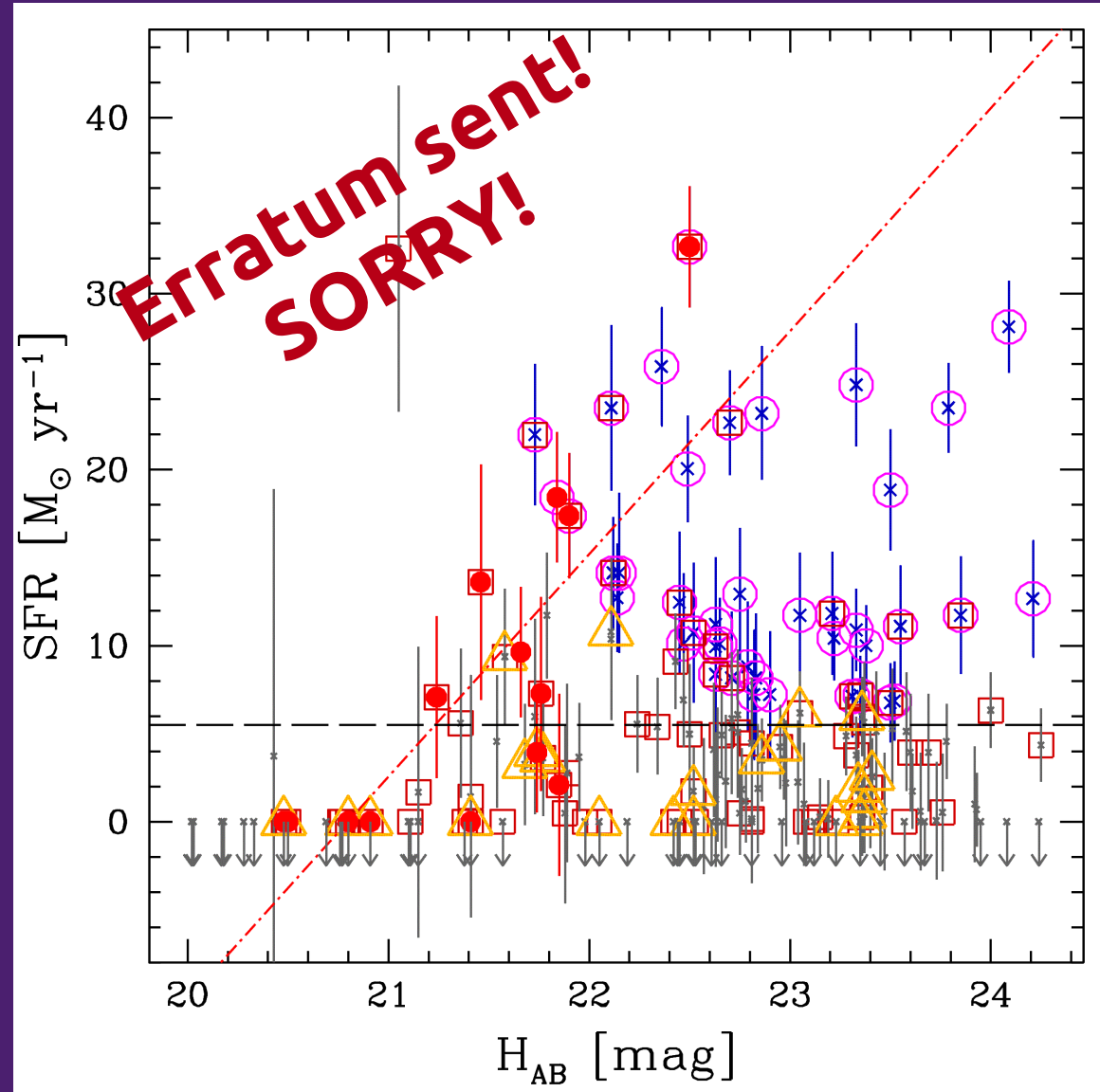
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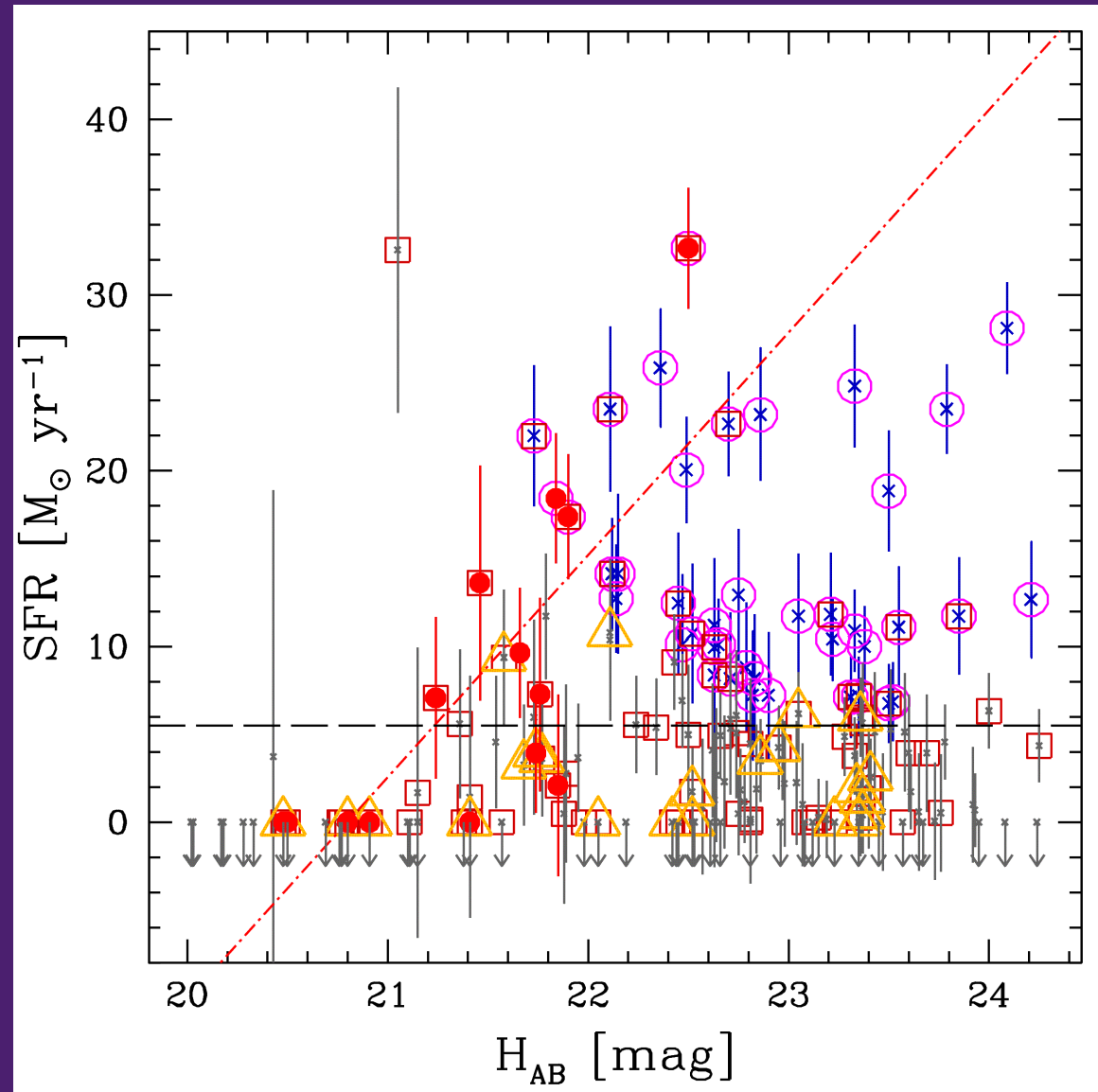
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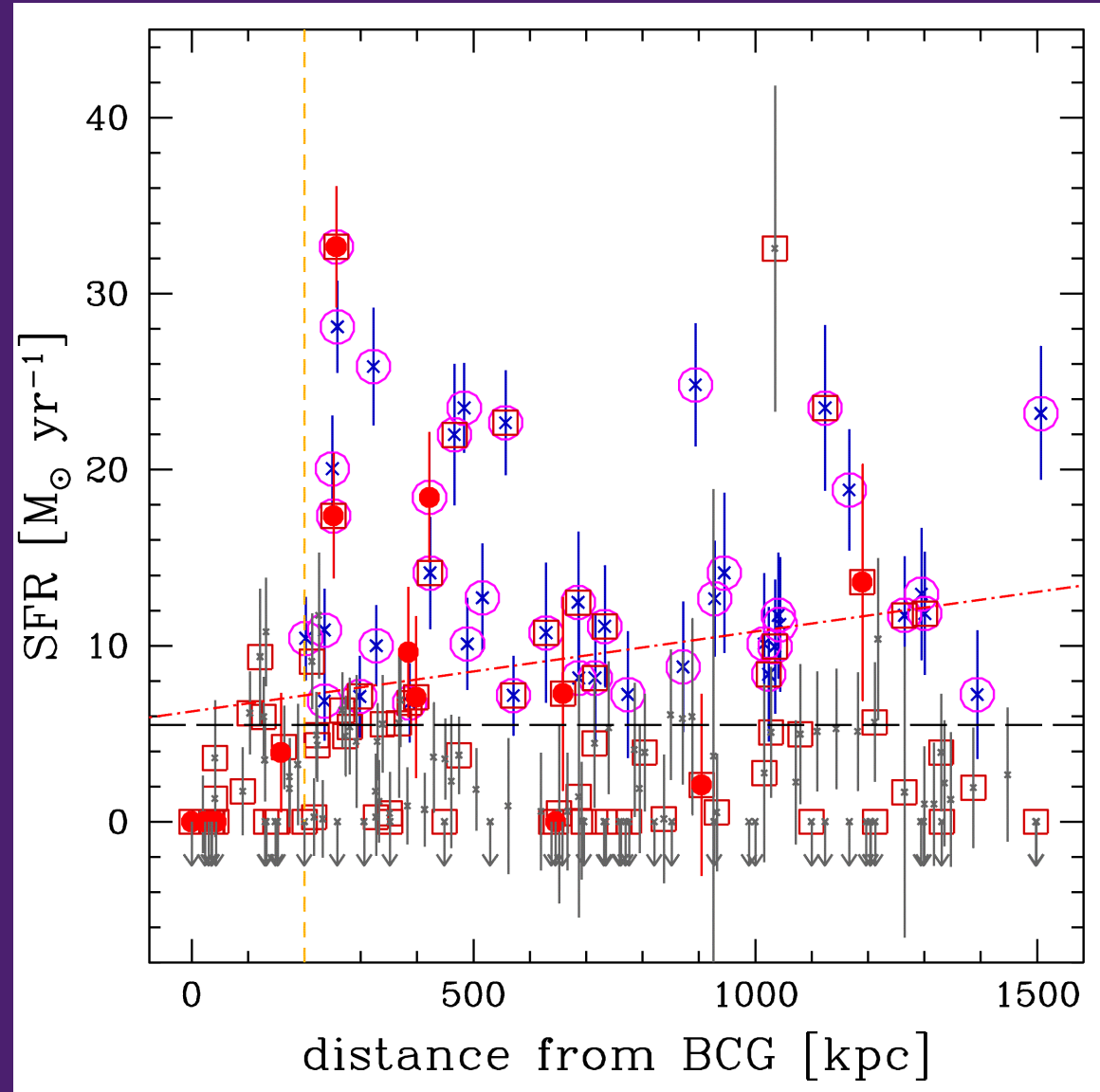
magenta circle: H-alpha emitter

orange triangle: within 200 kpc

**No** H-alpha emitters within a 200 kpc radius of the brightest cluster galaxy.

**No** increase of SFR with distance from BCG.

*Bauer+11, Grützbauch+12*



# Specific SFR and stellar mass

- $M^*$  from K-band magnitude
- specific SFR = SFR per unit  $M^*$
- comparison field sample at  $z \sim 1.5$  (Pérez-González+08, Bauer+11b):

blue pentagons: IR-based SFRs

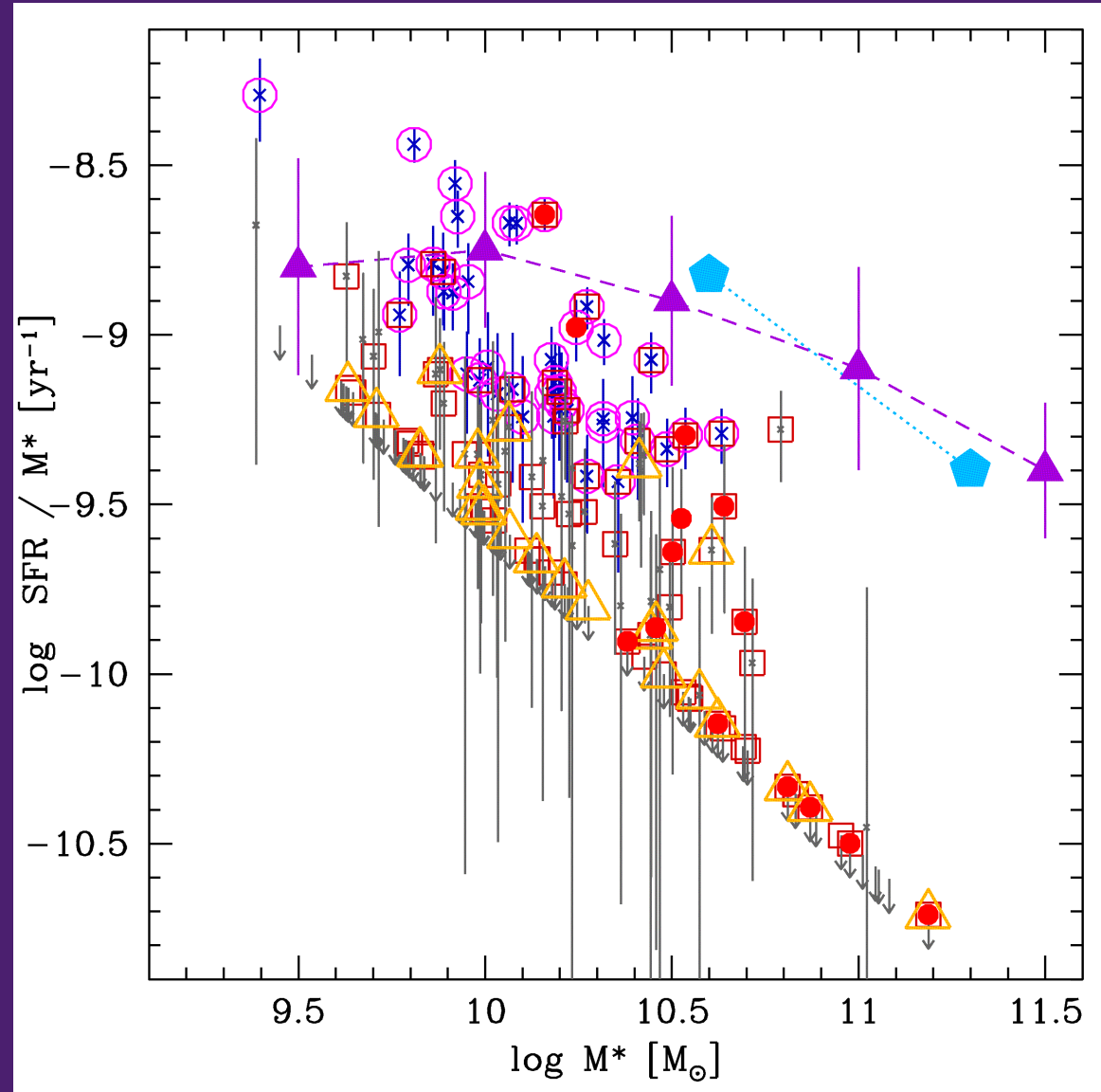
violet triangles: UV-based SFRs

No SF at  $M^* > 5 \times 10^{10} M_\odot$

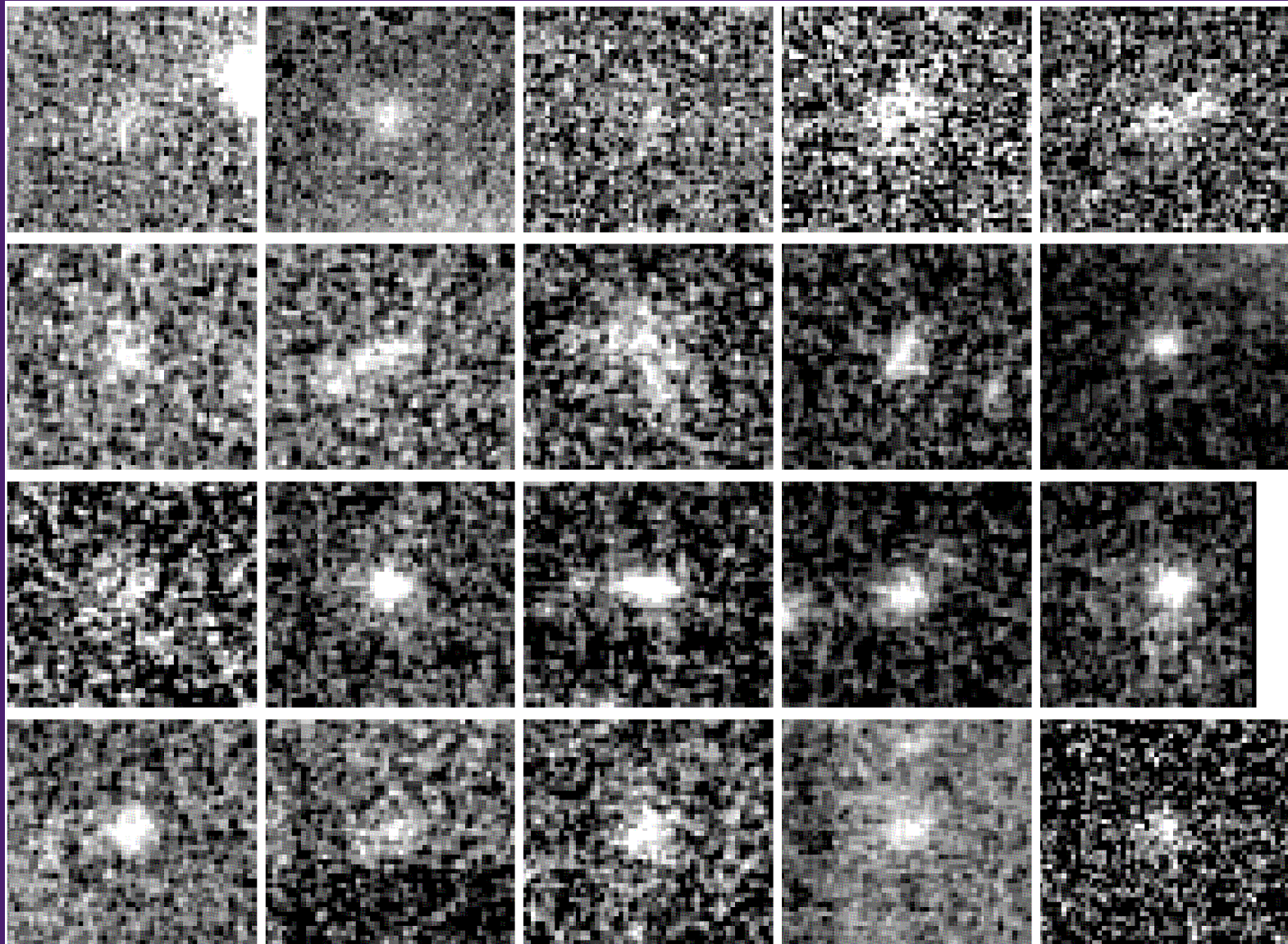
At the same stellar mass galaxies within  $R_Q$  have lower SFRs

Only at  $M^* < 10^{10} M_\odot$  typical field SFRs are reached

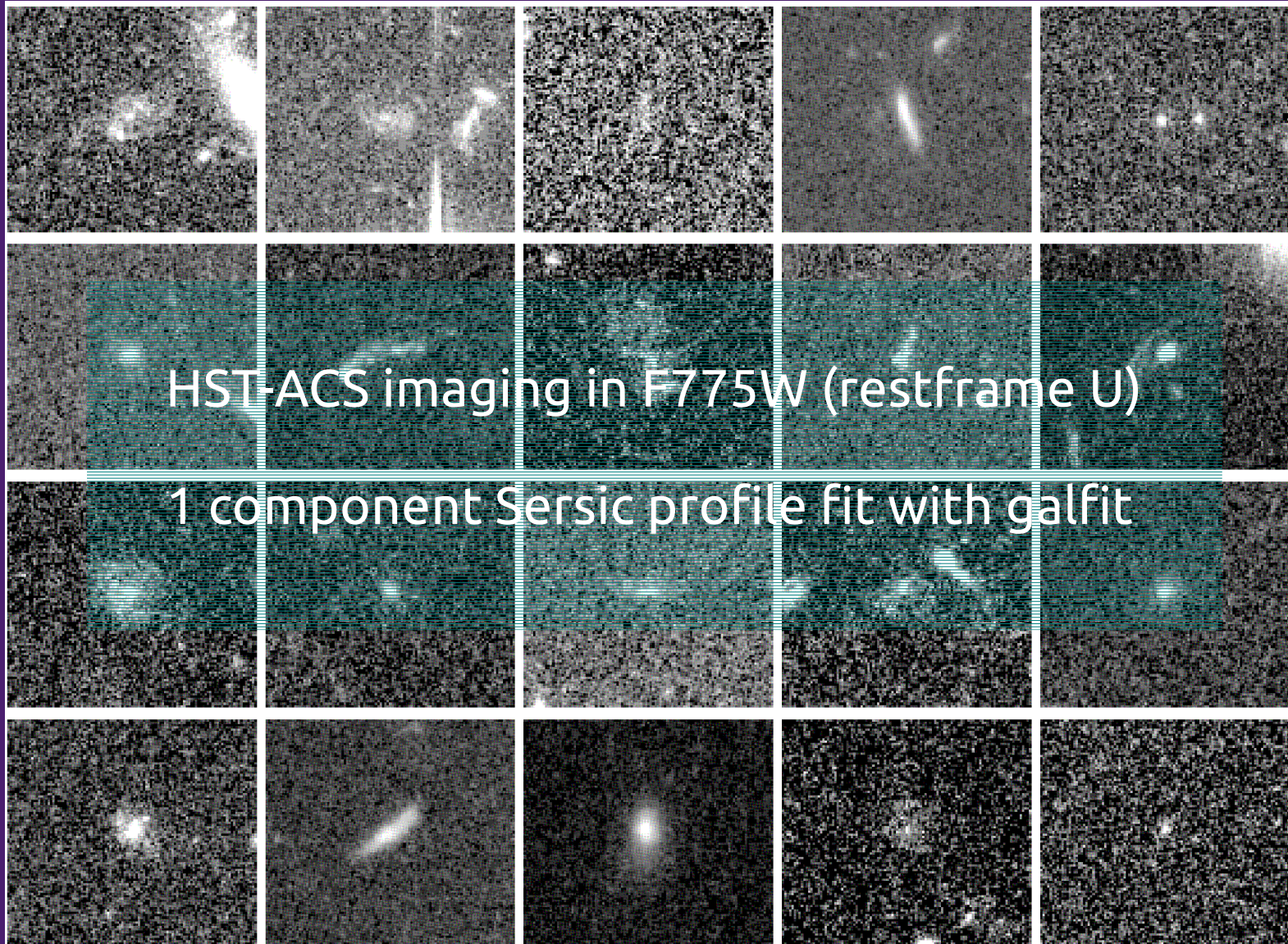
*Grützbauch+12*



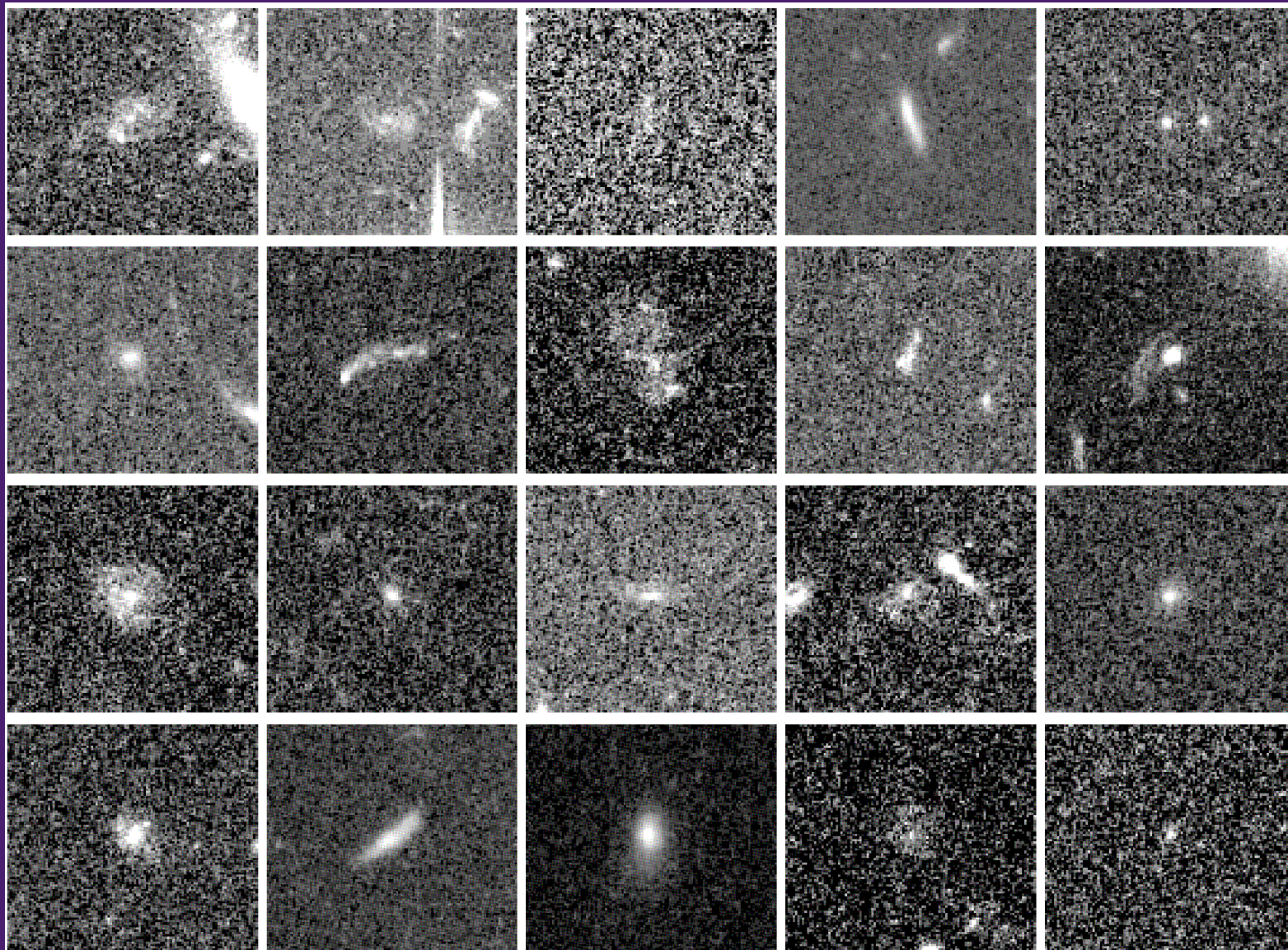
# How do they look? - H $\alpha$



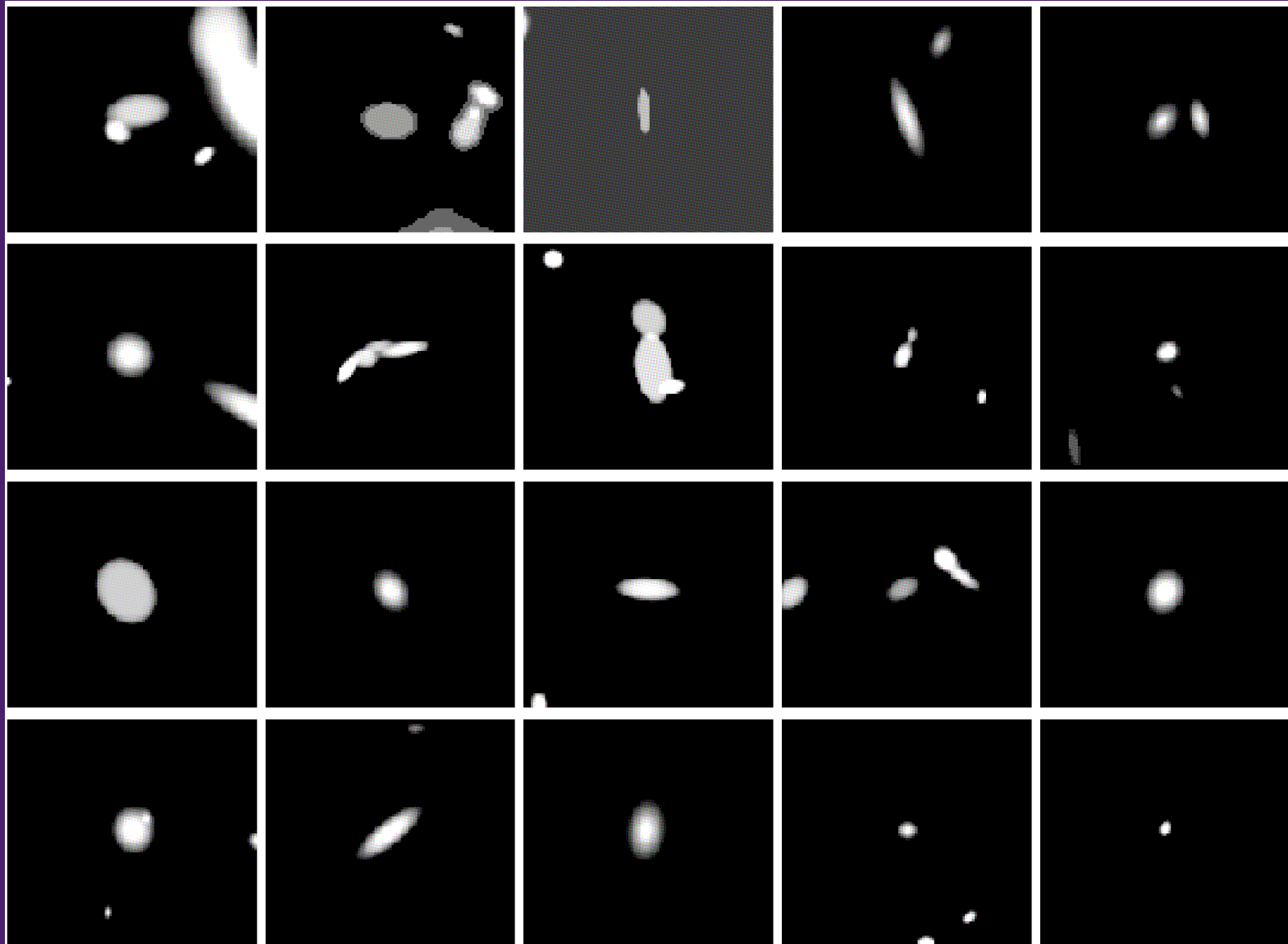
# Morphologies: F775W (rest U)



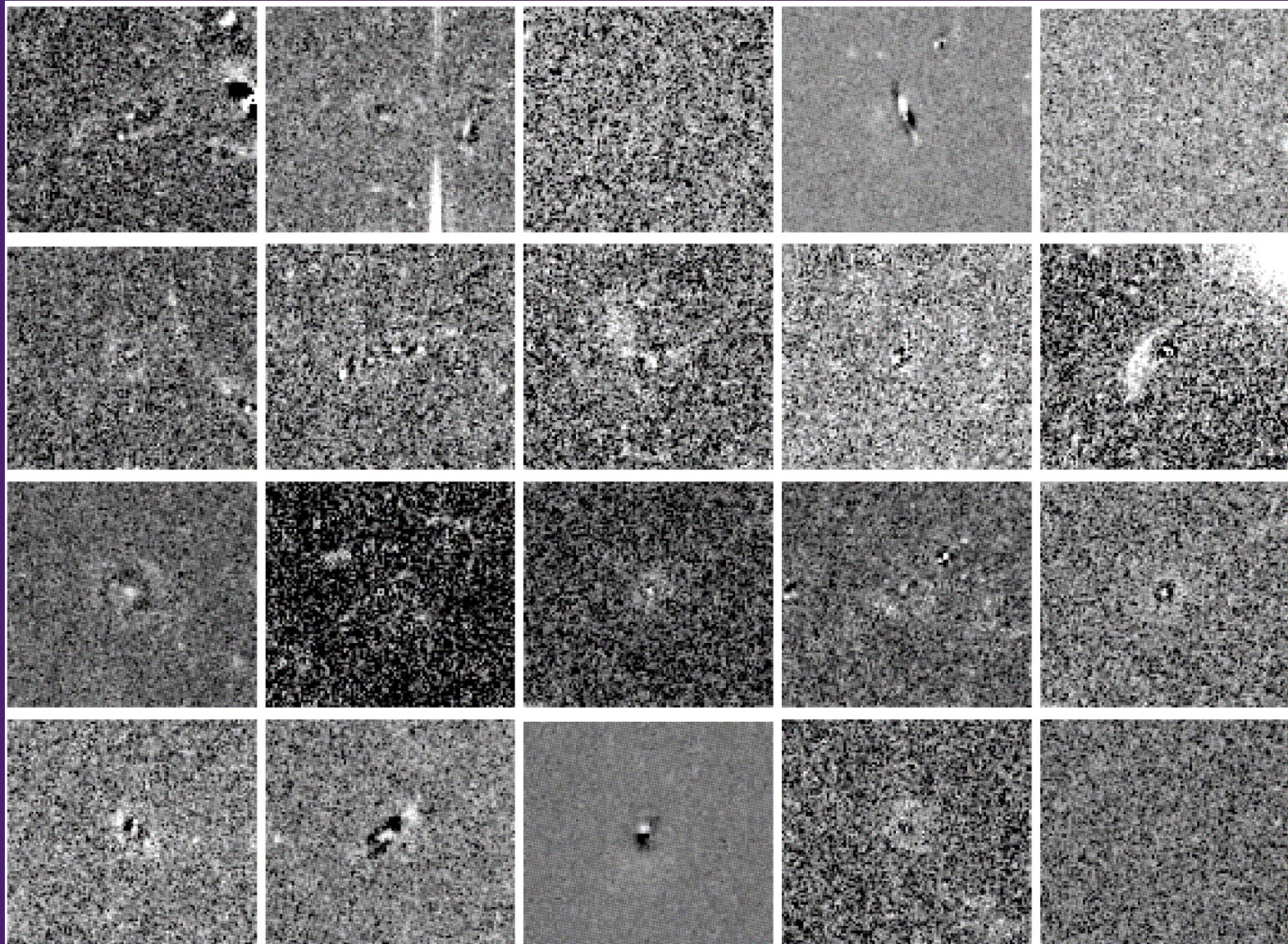
# Morphologies: F775W (rest U)



# Morphologies: models



# Morphologies: residuals



# Morphology: $R_{\text{eff}}$ and Sersic index $n$

Effective radius  $R_{\text{eff}}$  and Sersic index  $n$  vs.  $M^*$  and  $sSFR$

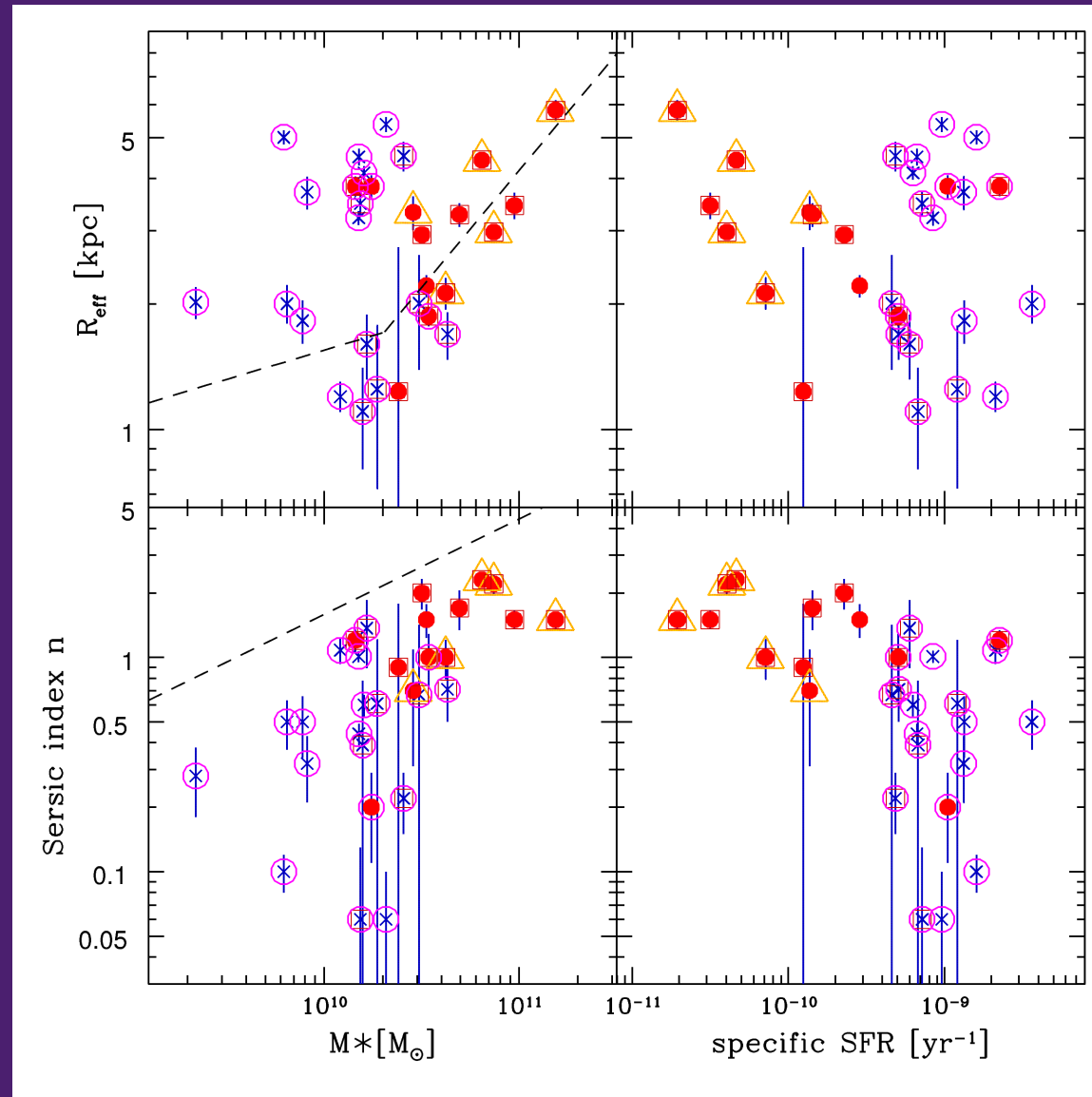
red: confirmed members

magenta circle: H-alpha emitter

orange triangle: within 200 kpc

Passive **members** follow local size-mass relation

**Emitters** are offset: too big for their stellar mass





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Effective radius  $R_{\text{eff}}$  and Sersic index  $n$  vs.  $M^*$  and  $sSFR$

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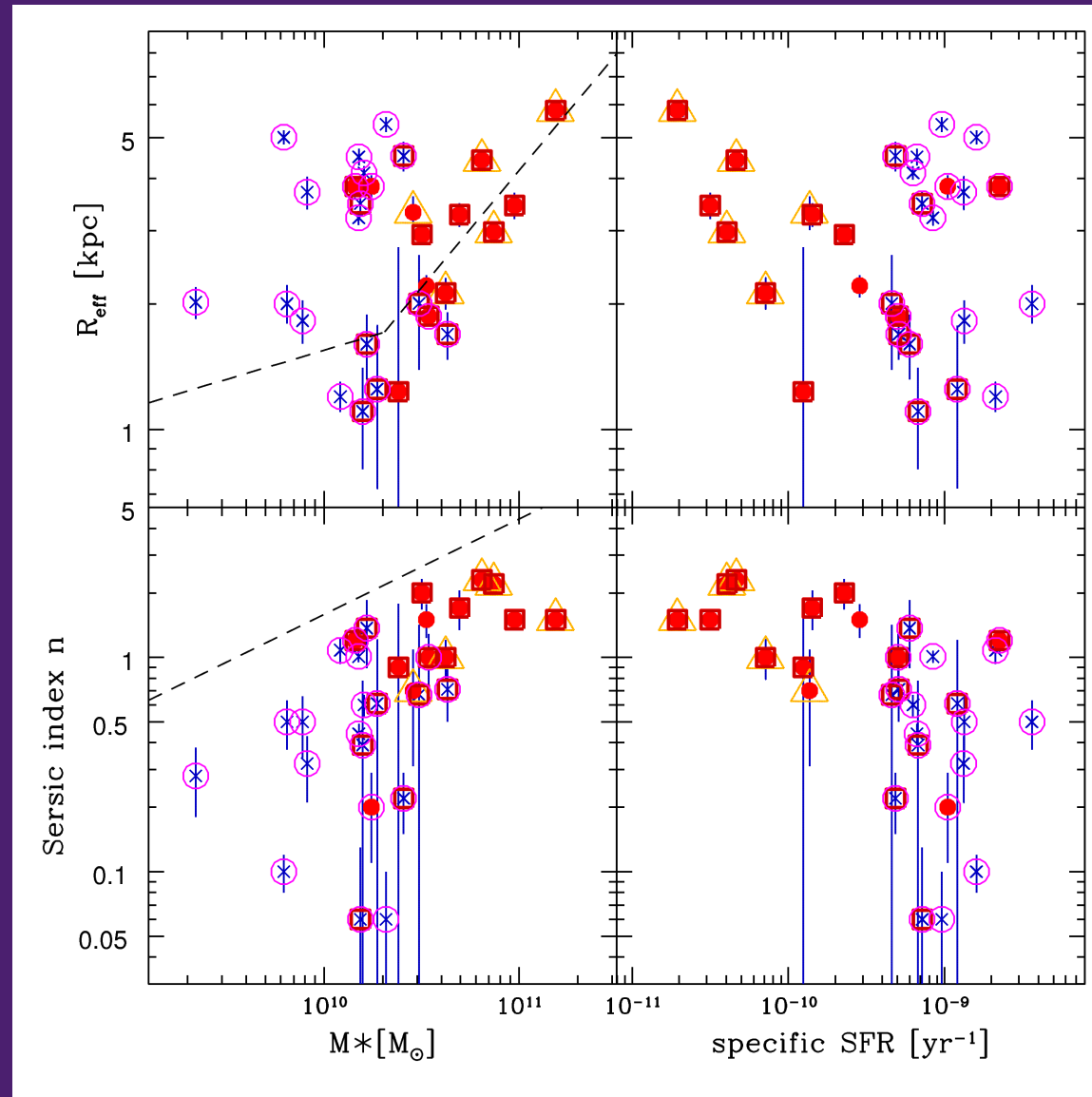
magenta circle: H-alpha emitter

orange triangle: within 200 kpc

Passive **members** follow local size-mass relation

**Emitters** are offset: too big for their stellar mass

But: tend to follow the local relation if on red sequence



# Morphology: CAS

CAS: Concentration, Asymmetry & clumpiness (Conselice 03)

--> non-parametric quantification of galaxy morphology

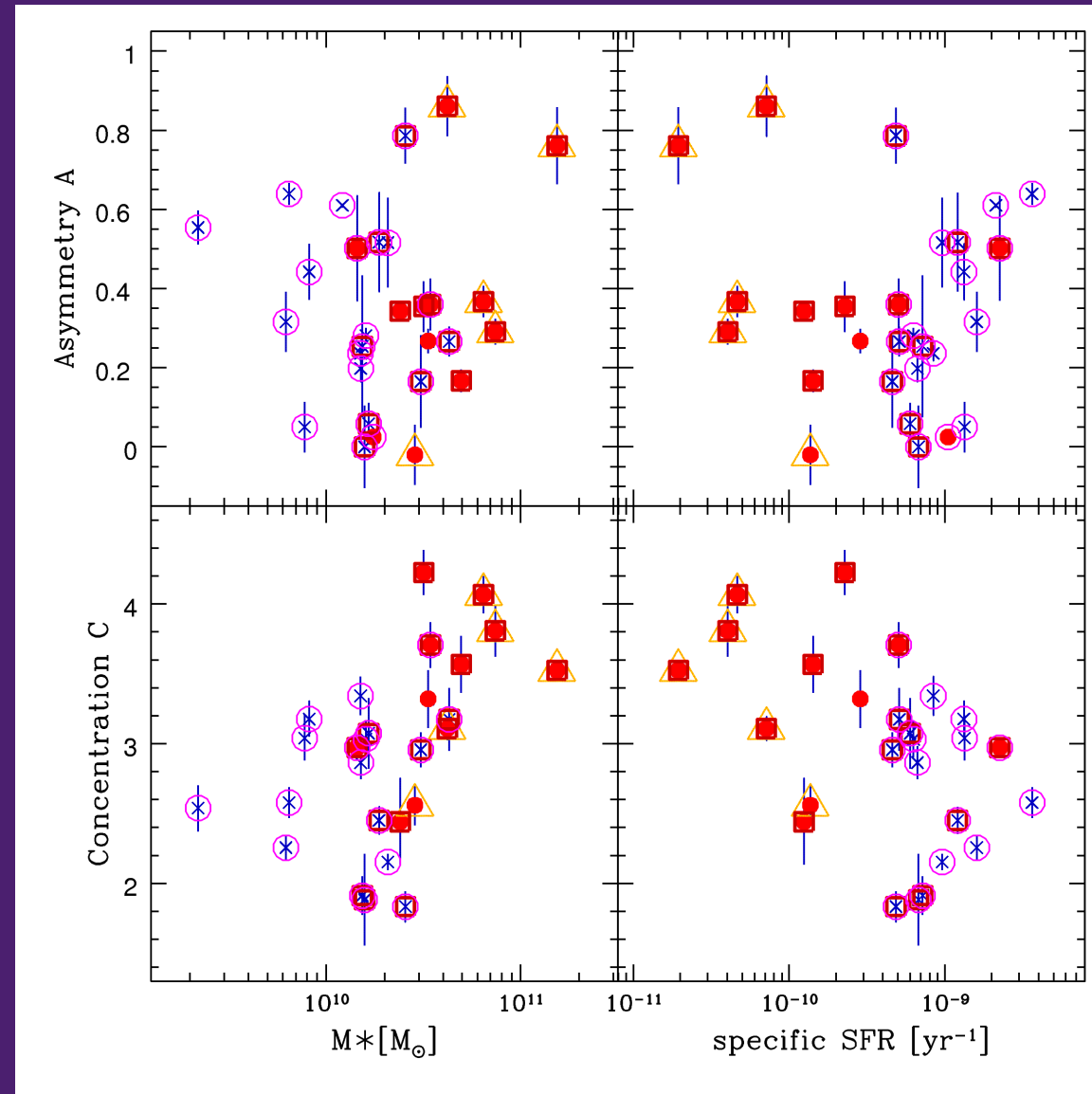
red: confirmed members

magenta circle: H-alpha emitter

orange triangle: within 200 kpc

C depends on  $M^*$

BCG and other central member show very high A  
--> recent merging?



# Summary

- Measure individual SFRs through H-alpha imaging in cluster at  $z=1.4$
- Quenching radius  $R_Q=200$  kpc, which coincides with the extension of the X-ray emission
- At the same stellar mass, galaxies  $< R_Q$  show lower specific SFRs
  - > overall no SF at  $M^*>5 \times 10^{10} M_\odot$
  - > typical field sSFRs only reached at  $M^*<10^{10} M_\odot$
- SF-ing galaxies have larger  $R_{\text{eff}}$  than passive members, who follow the local size- $M^*$  relation.
  - > But: excess emitters on the red sequence are more compact too. H-alpha emission from AGN?
- High Asymmetry in BCG --> recent merging?