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The LEGA-C Survey of 4000 Galaxies at z 1: stellar populations and stellar kinematics

Wel, A. van der; Bezanson, R.; Franx, M.; Straatman, C.; D'Eugenio, F.; Gallazzi, A.; ... ; Bell, E.

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The LEGA-C Survey of 4000 $z \sim 1$ Galaxies

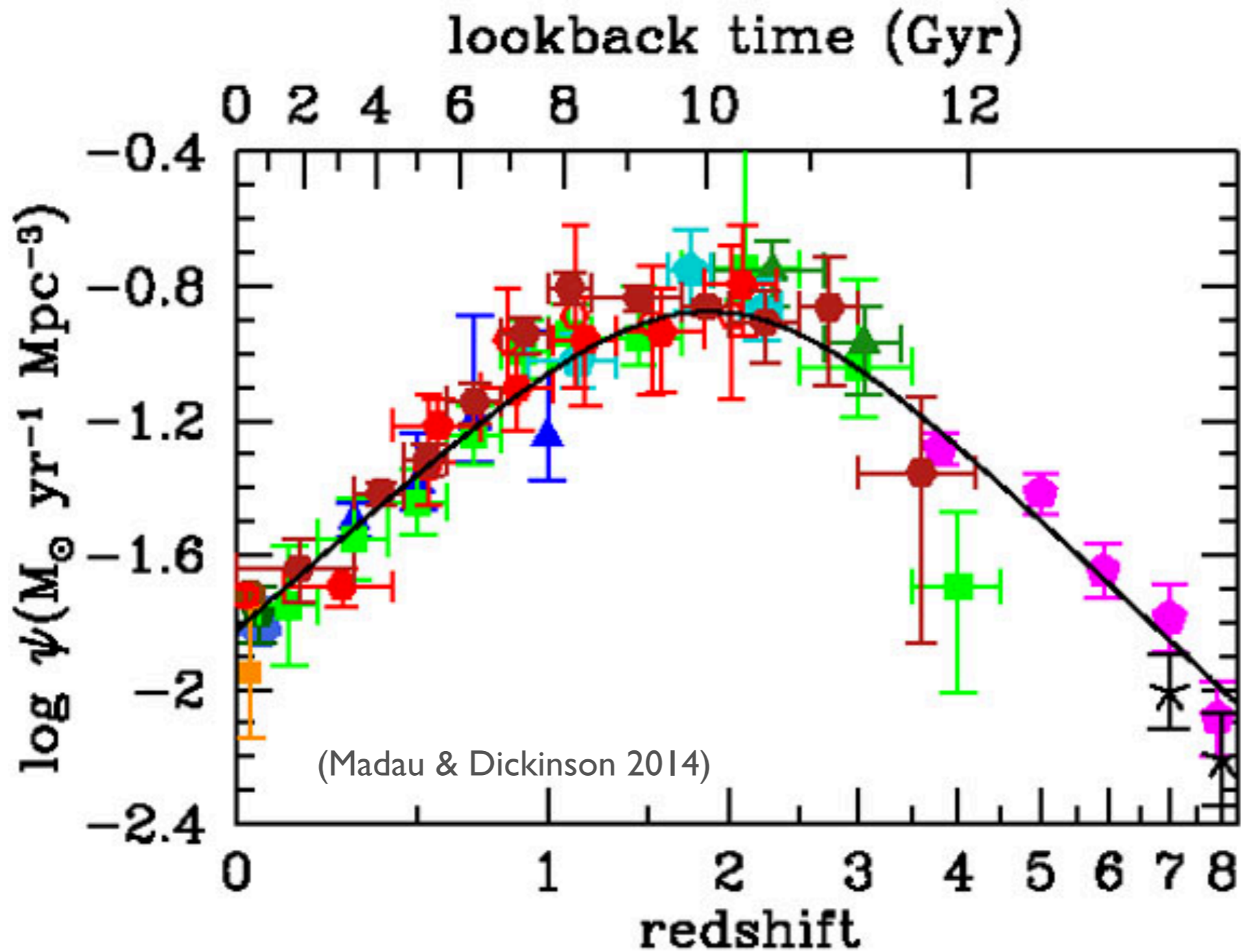
Stellar Populations and Stellar Kinematics

Arjen van der Wel (PI)

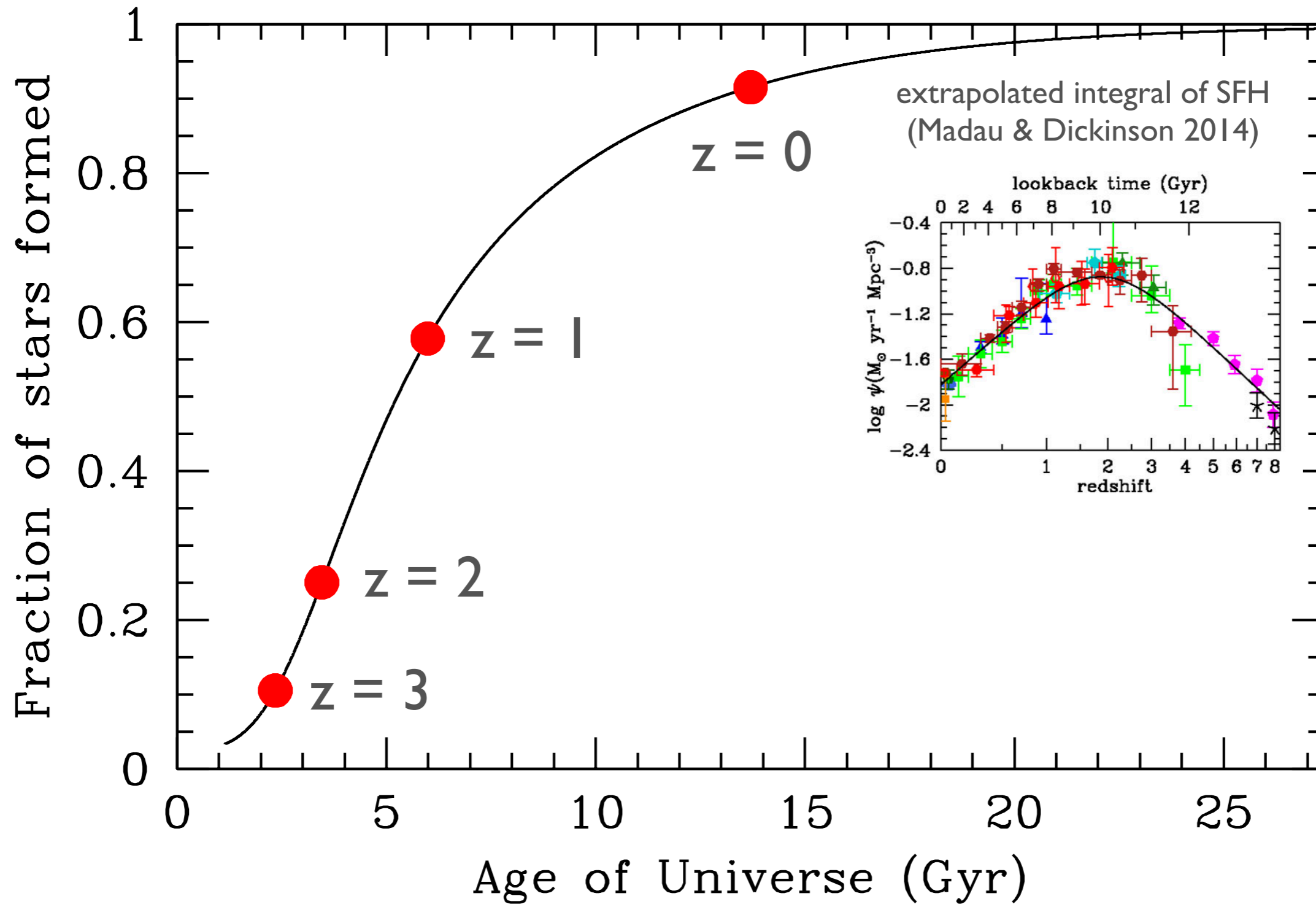
Ghent University, Belgium

Rachel Bezanson, Marijn Franx, Carolinestraatman, Francesco D'Eugenio, Anna Gallazzi, Po-Feng Wu, Michael Maseda
Ivana Barisic, Joshua van Houdt, Anna de Graaff, Tania Barone, Stefano Zibetti, Camilla Pacifici, Eric Bell
and LEGA-C collaboration

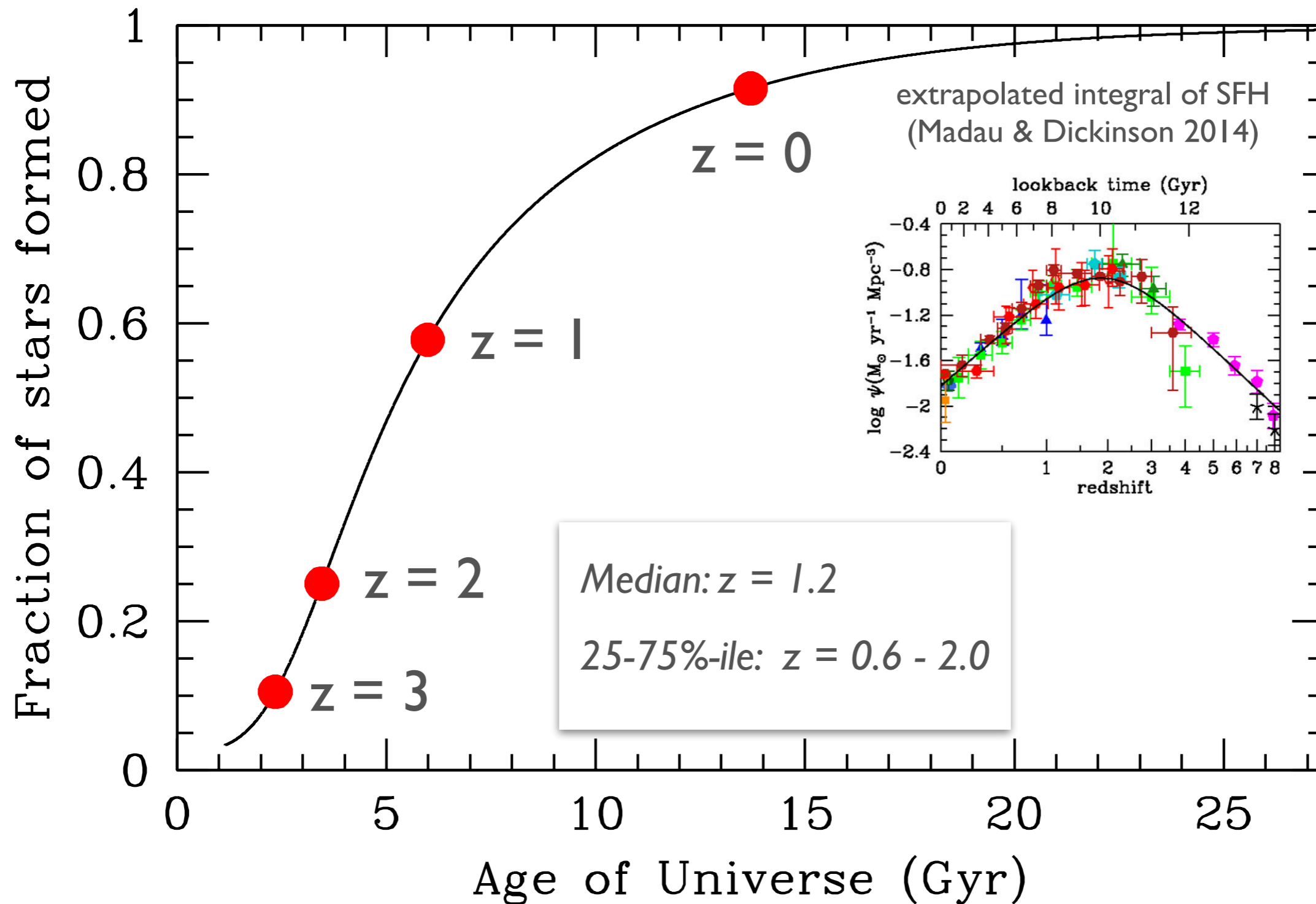
Star Formation History (& Future)



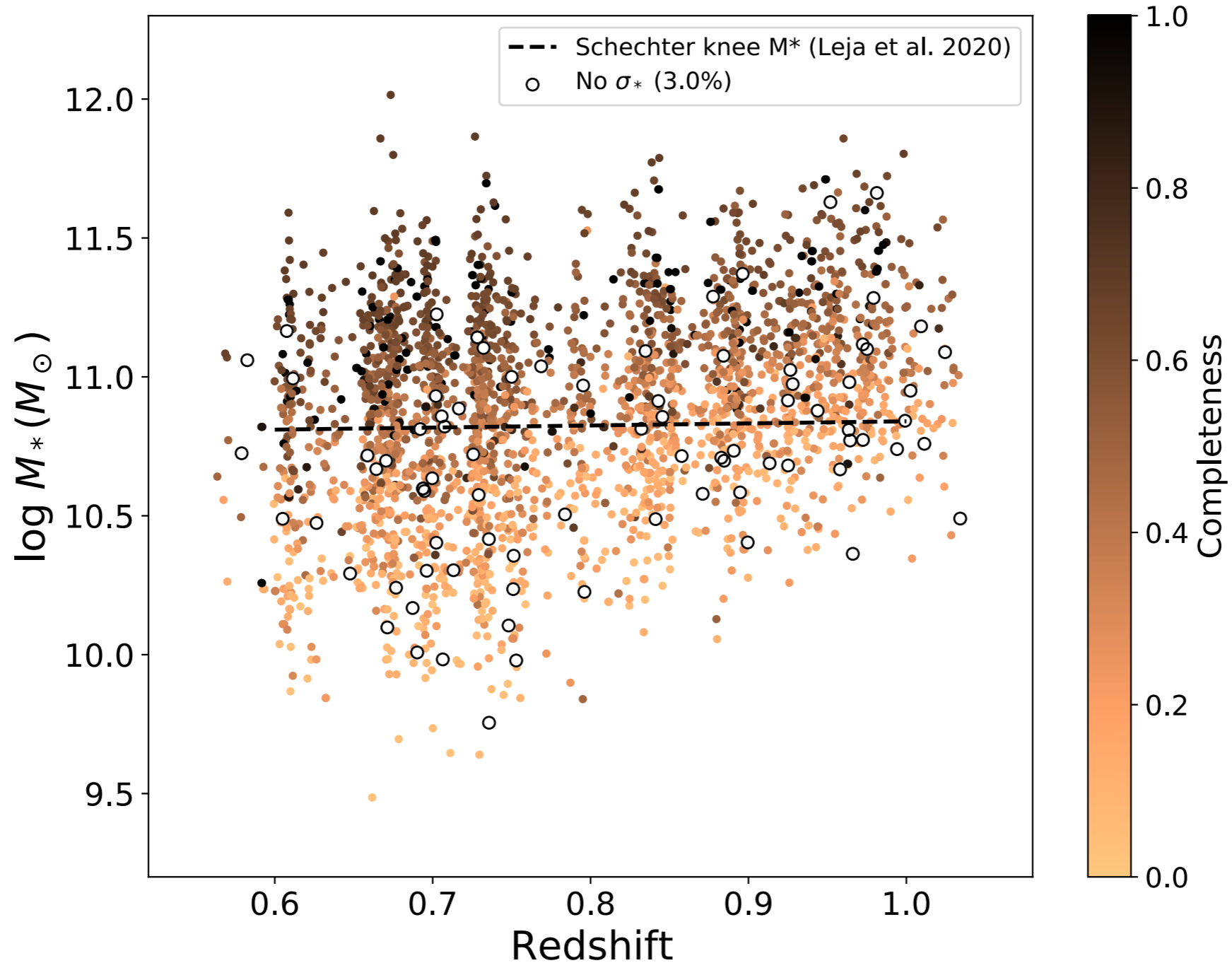
Star Formation History (& Future)



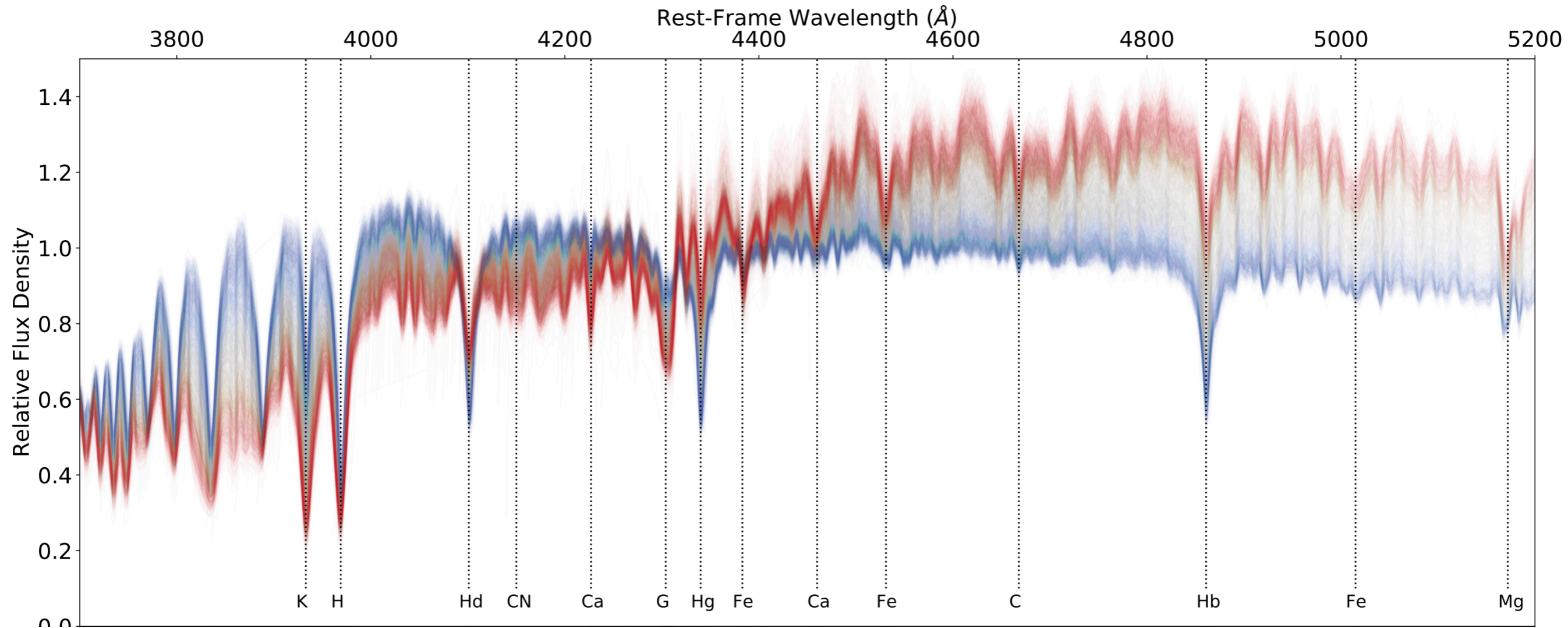
Star Formation History (& Future)



128 night allocation on VLT; 20h integrations; typical S/N = 20/Å at R~4500

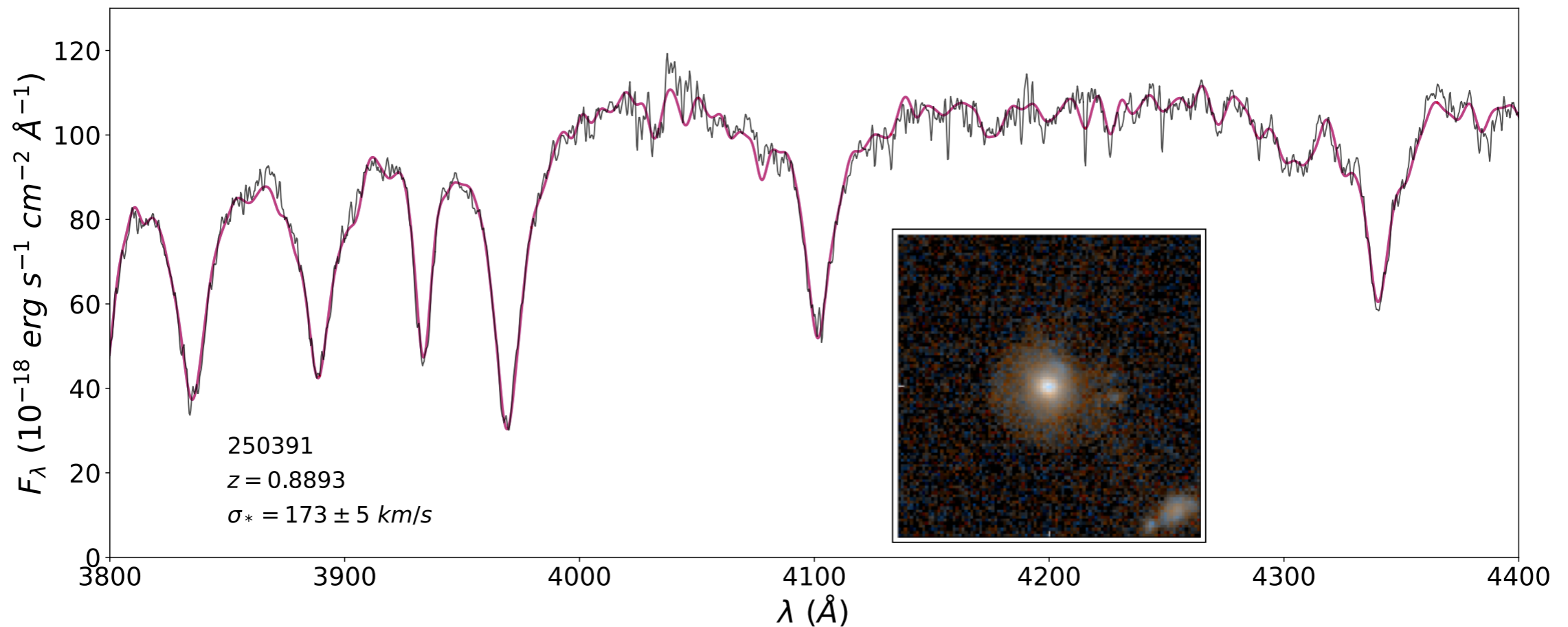


2707 spectra of $z \sim 0.8$ galaxies



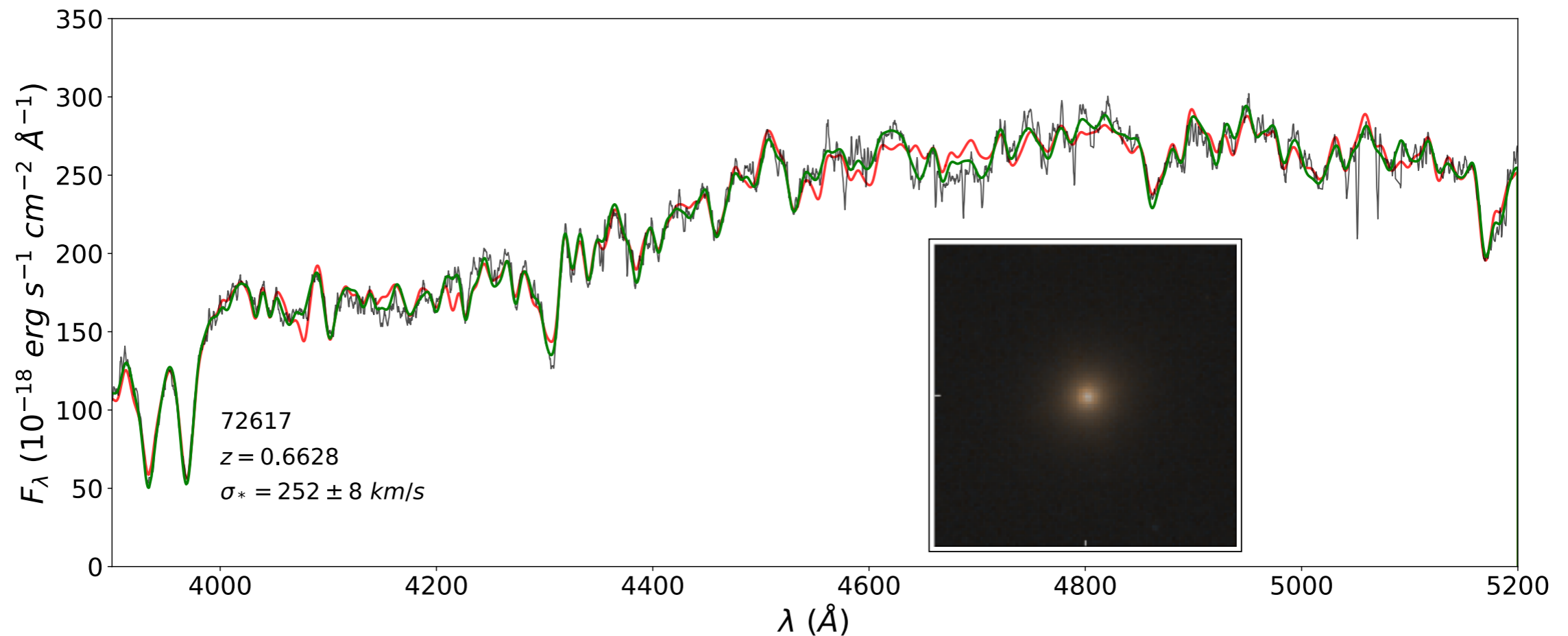
- All spectra with measured stellar velocity dispersions and H γ absorption index
- Sorted by strength of H γ . Blue: strong (young age); Red: weak (old age)
- Polynomials removed: effect of dust taken out

Example spectra: a post-starburst galaxy



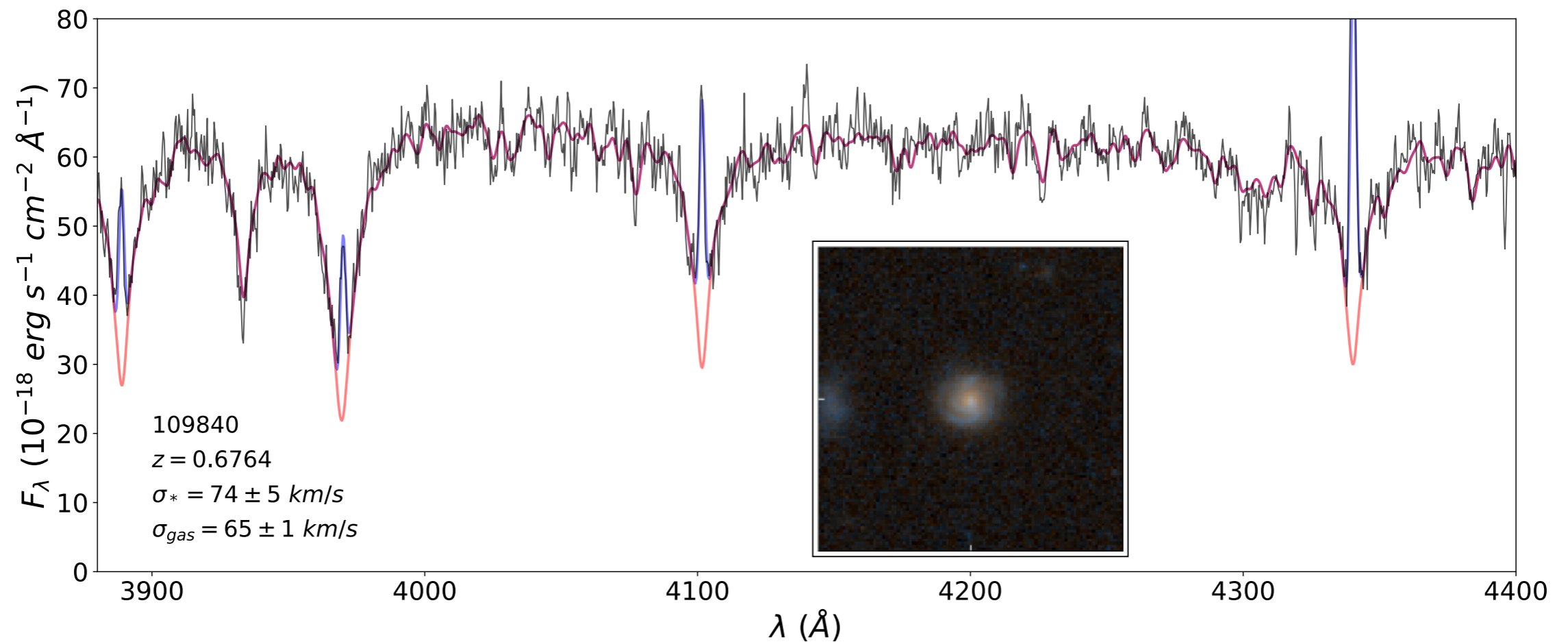
- Spectra in black
- Conroy SPS model in red; broadened by velocity dispersion (pPXF; Cappellari 2017)

Example spectra: an old elliptical



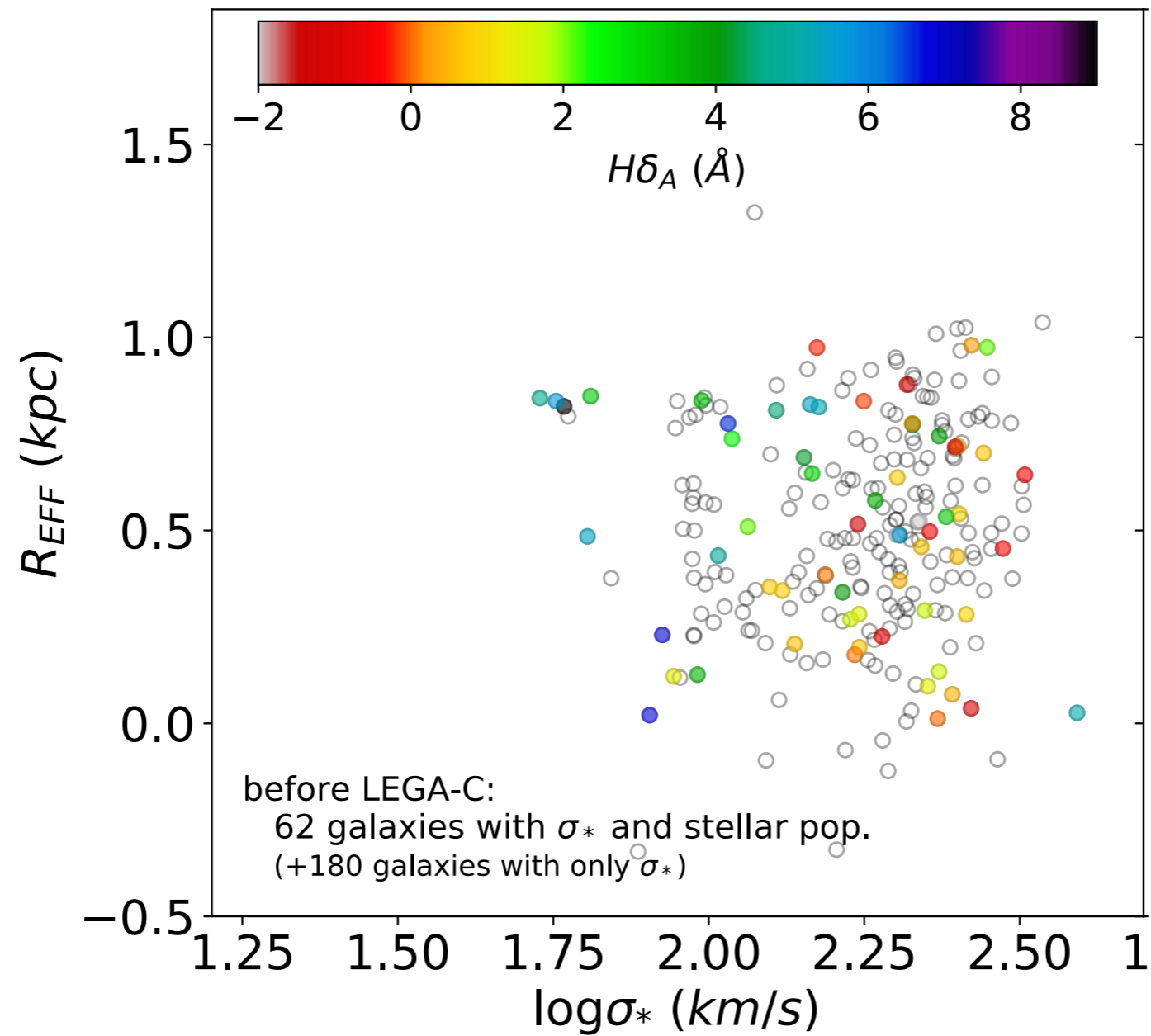
- Spectra in black
- Conroy SPS model (theoretical templates) in red has higher spectral resolution
- Vazdekis SPS model (empirical templates) in green fits better for old galaxies

Example spectra: a young spiral



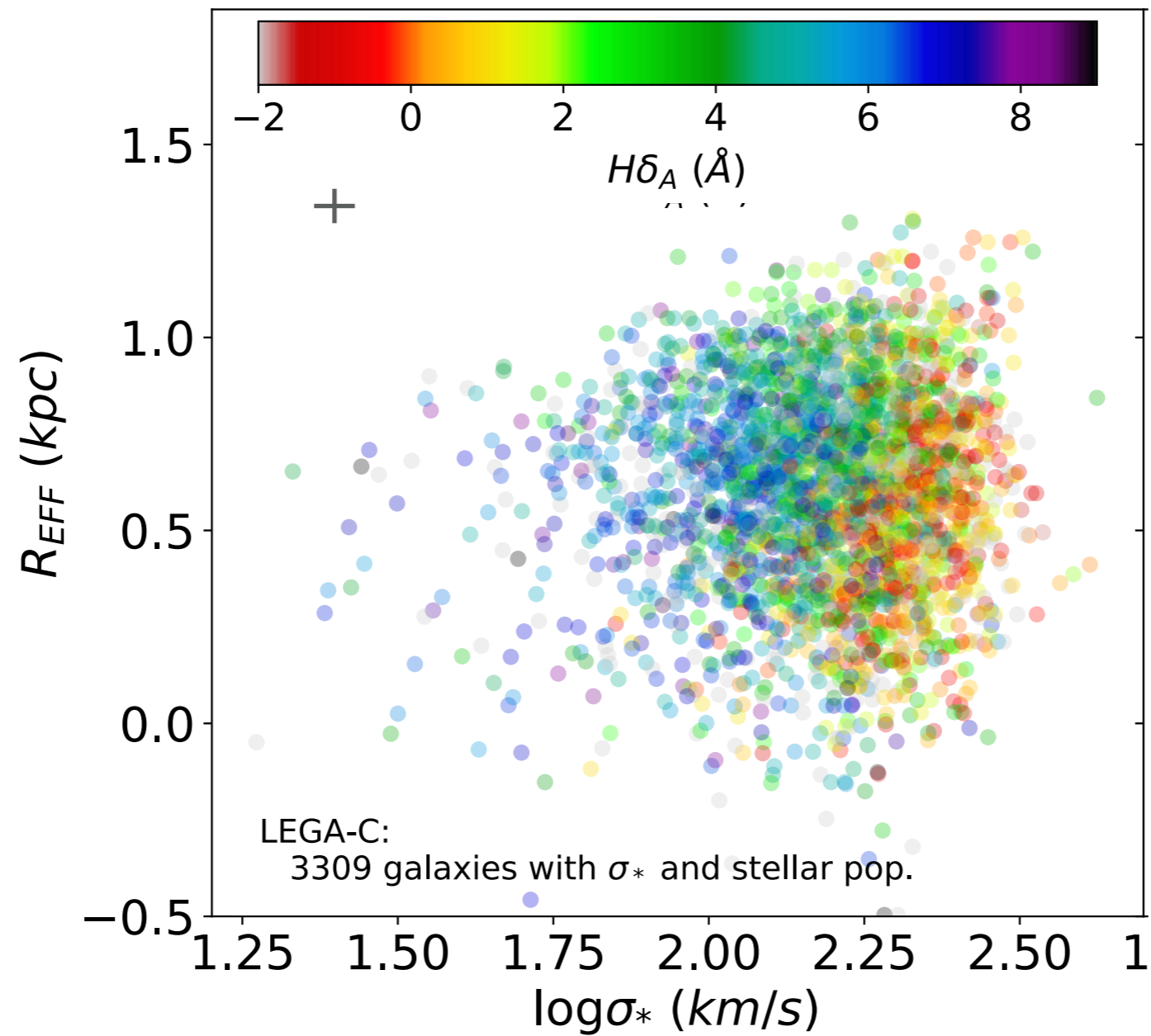
- Spectra in black
- Conroy SPS model in red
- + Emission lines in blue (joint SPS+lines fit with pPXF)

Before LEGA-C



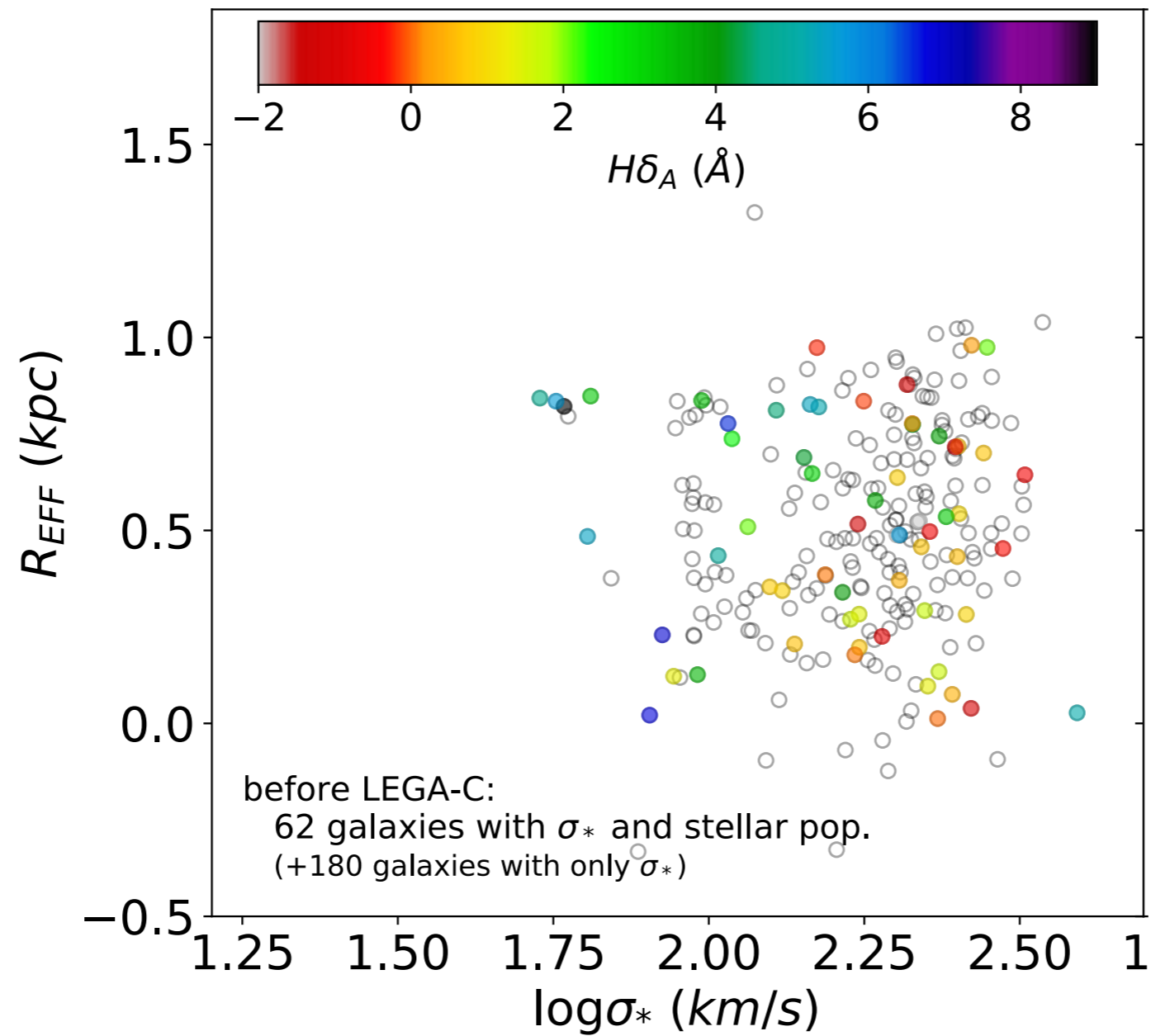
van der Wel+05; Treu+05, Gallazzi+14, Bezanson+14

After LEGA-C



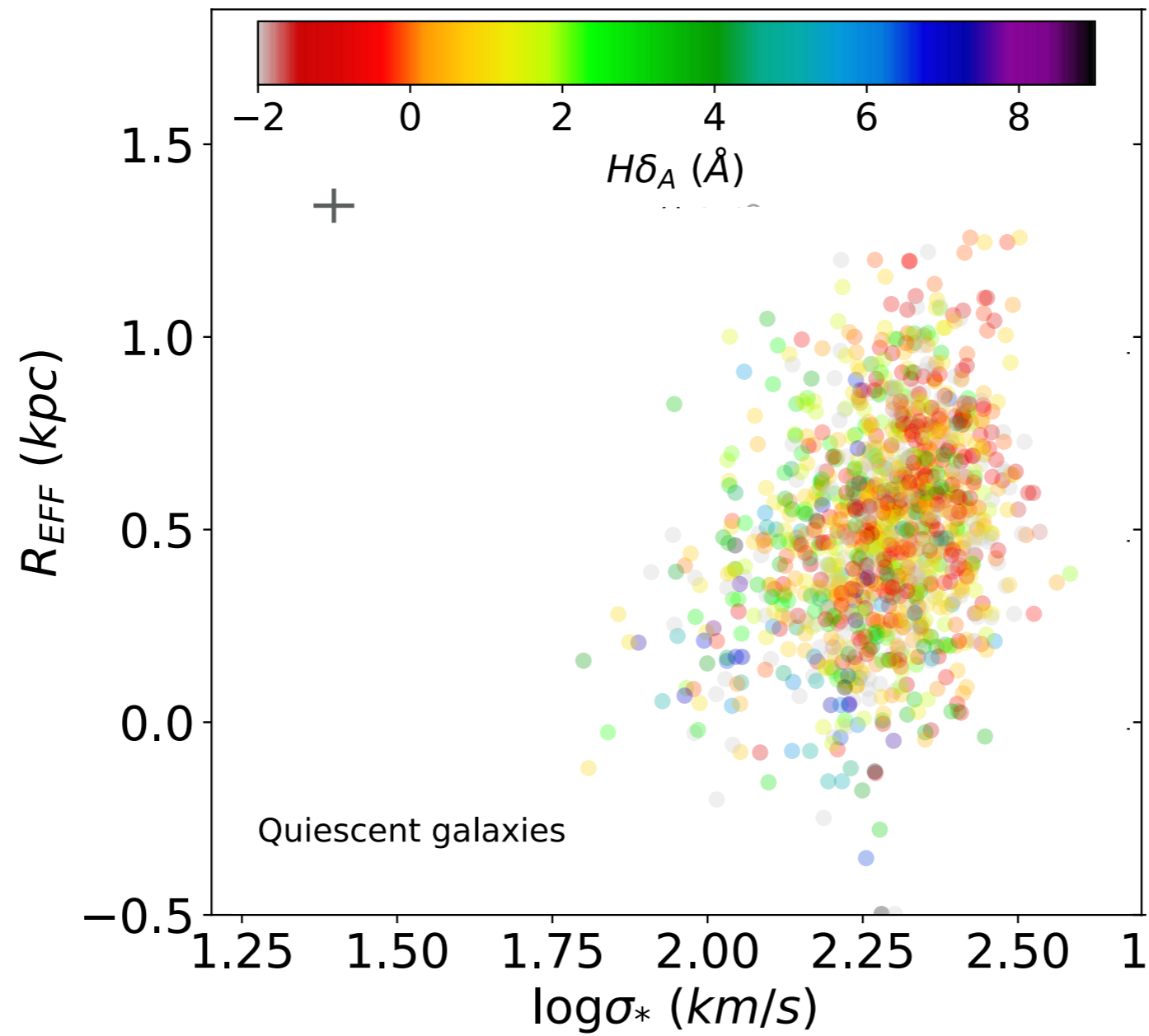
50-fold increase in sample size

Before LEGA-C

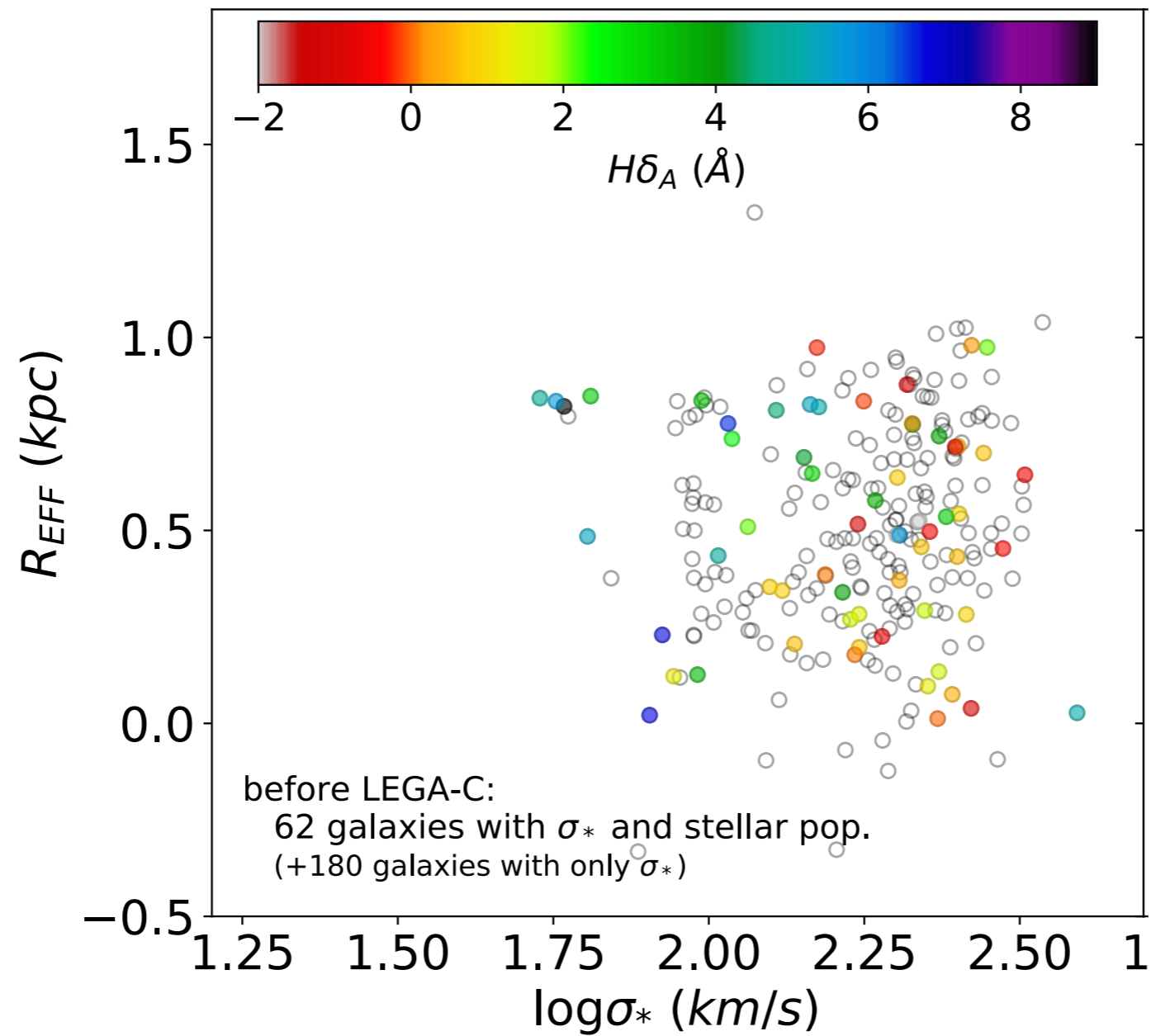


van der Wel+05; Treu+05, Gallazzi+14, Bezanson+14

Quiescent Galaxies

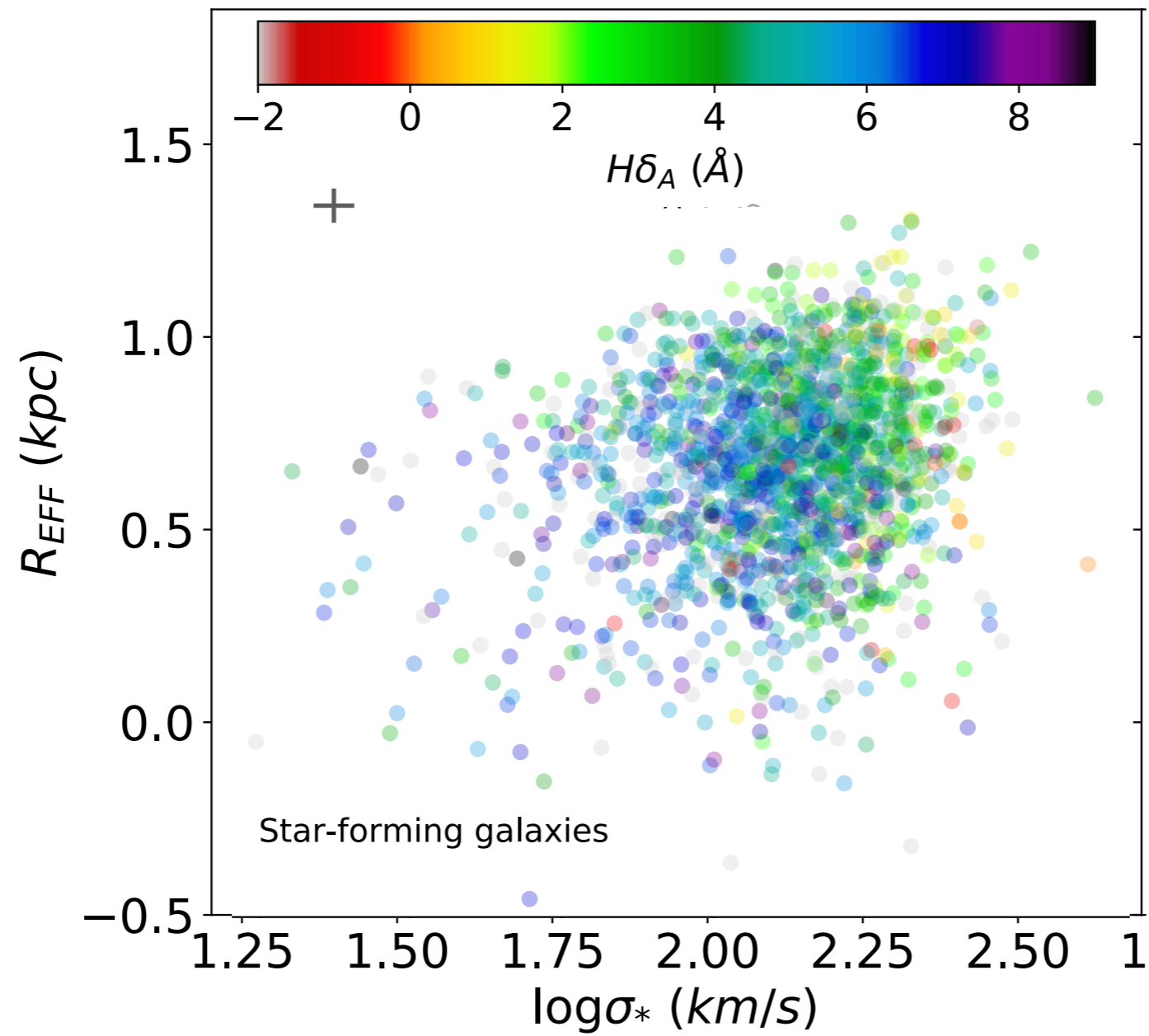


Before LEGA-C

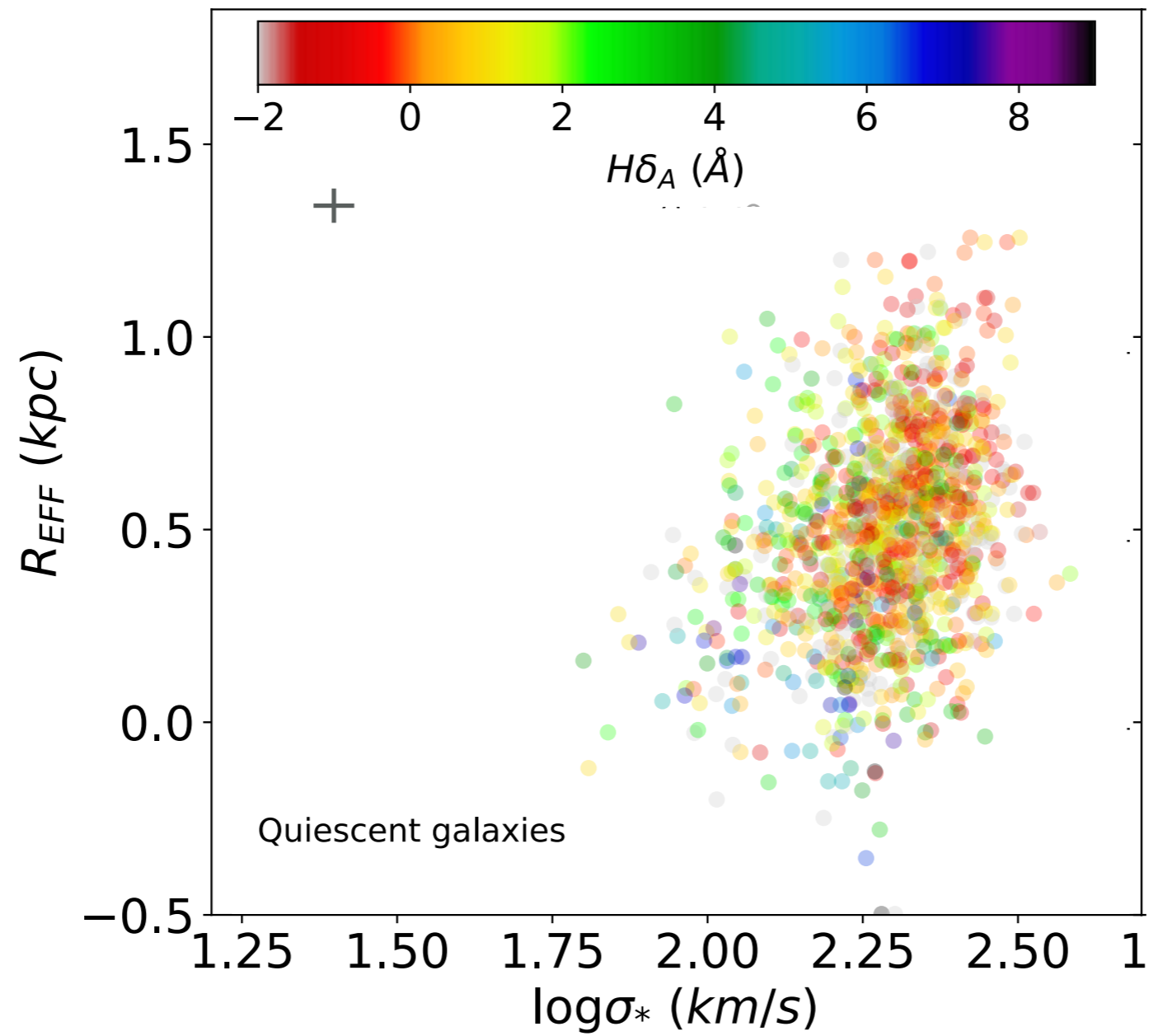


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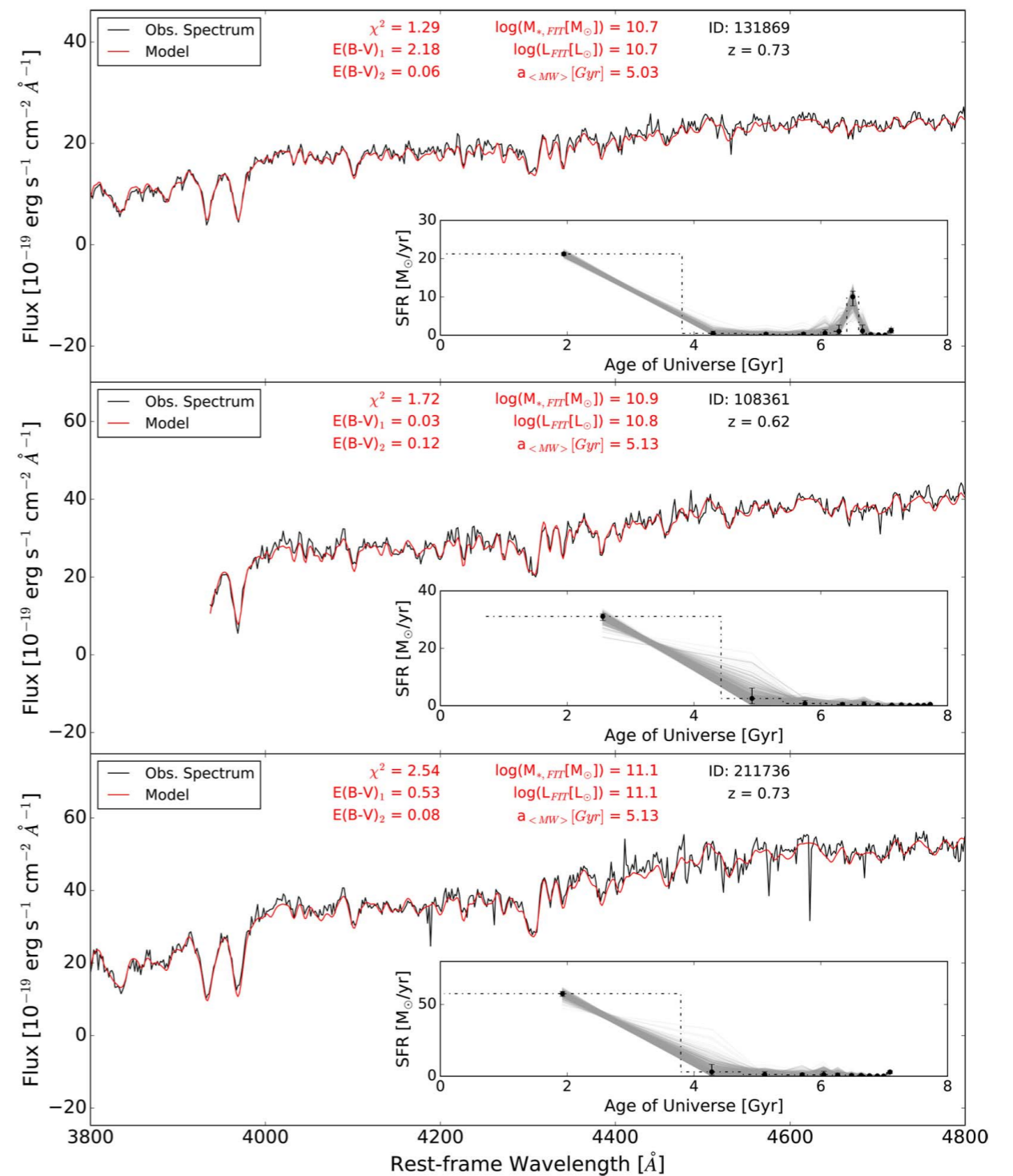
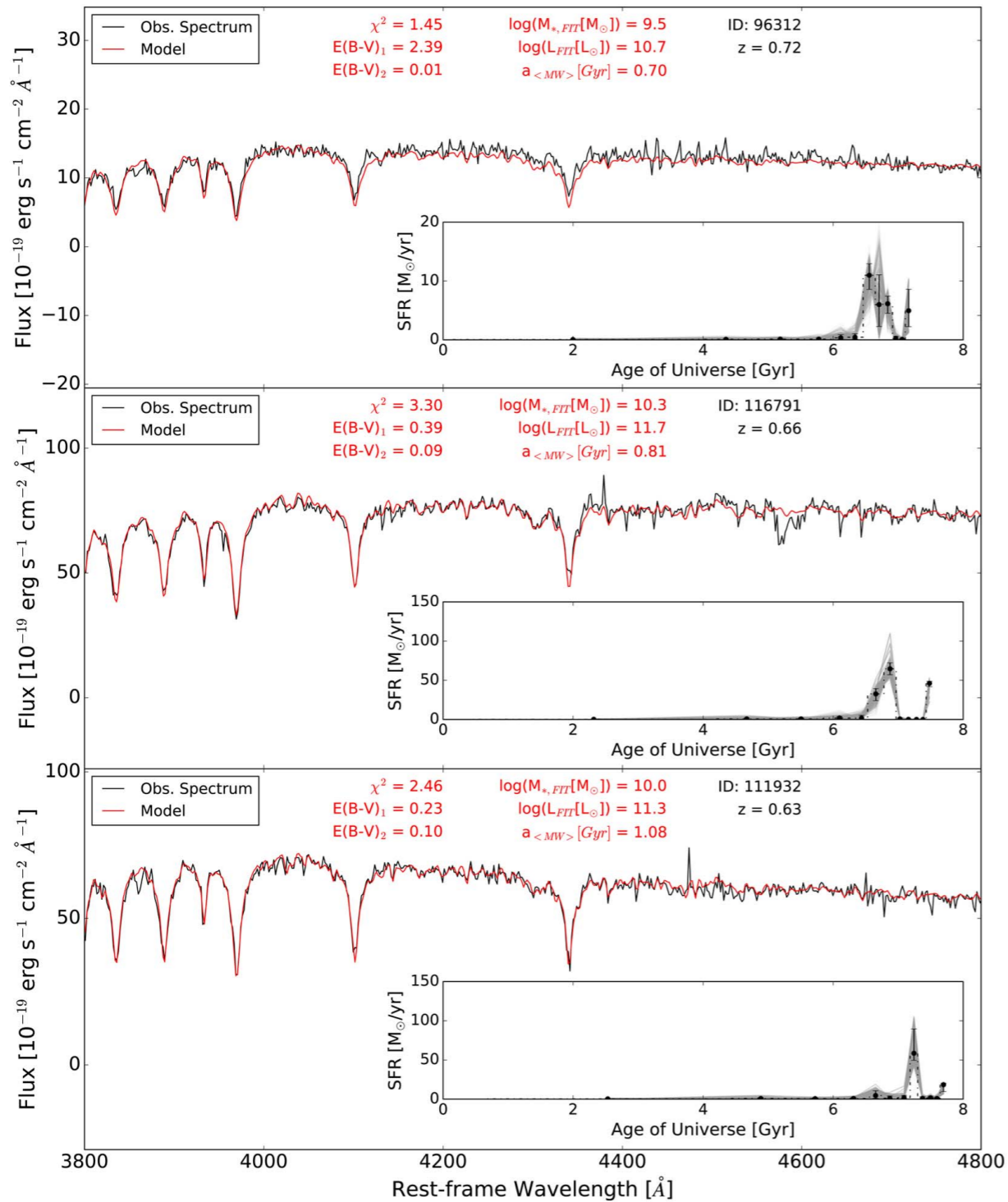
Star-forming Galaxies



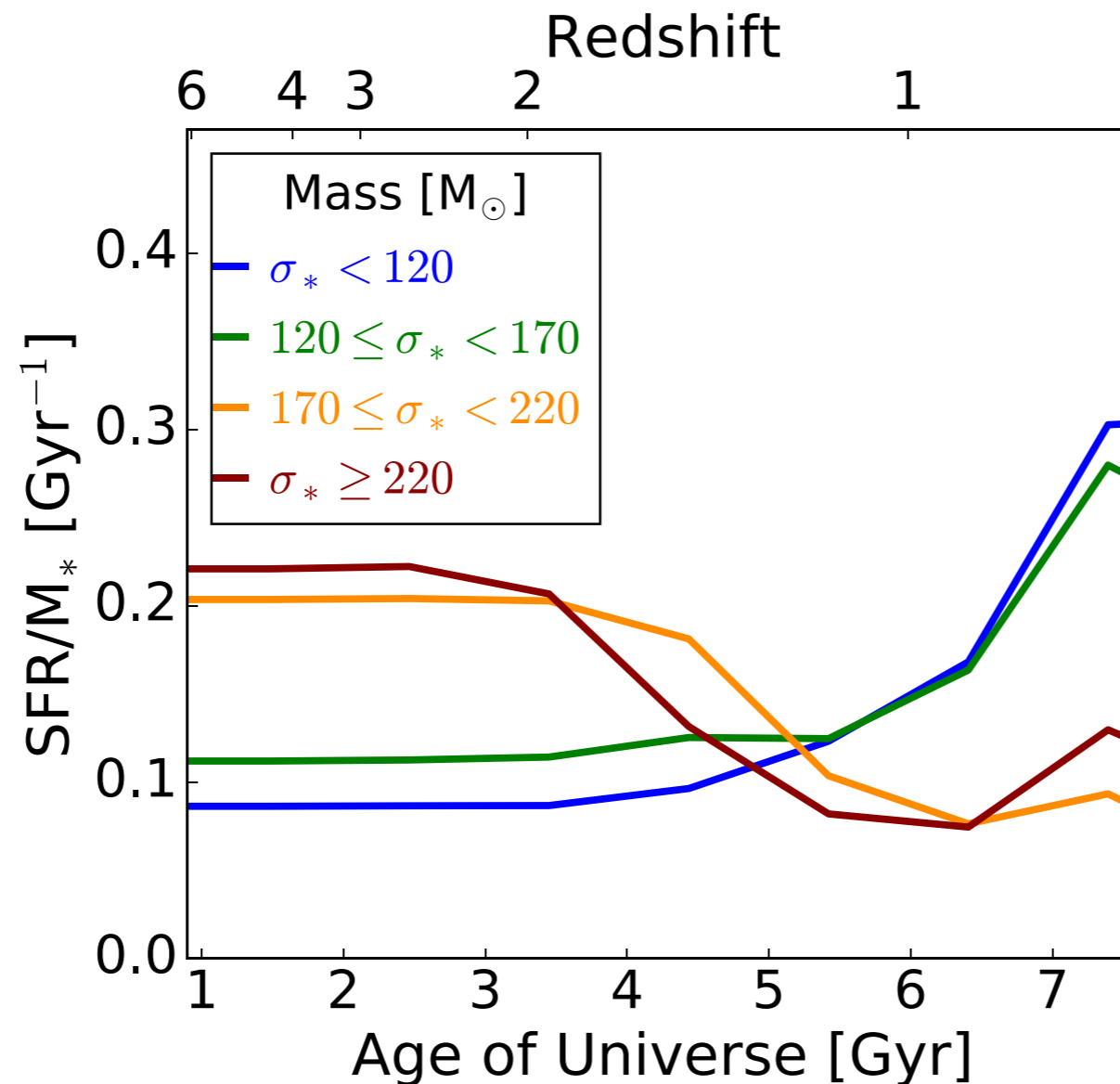
Quiescent Galaxies



Reconstruction of Star Formation Histories

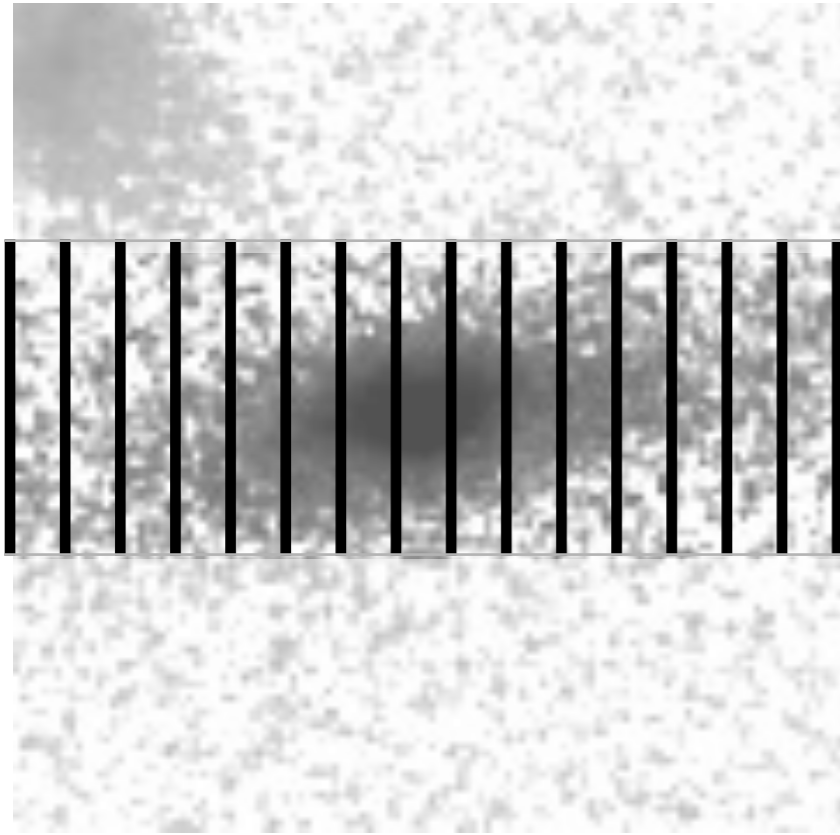


Reconstruction of Star Formation Histories

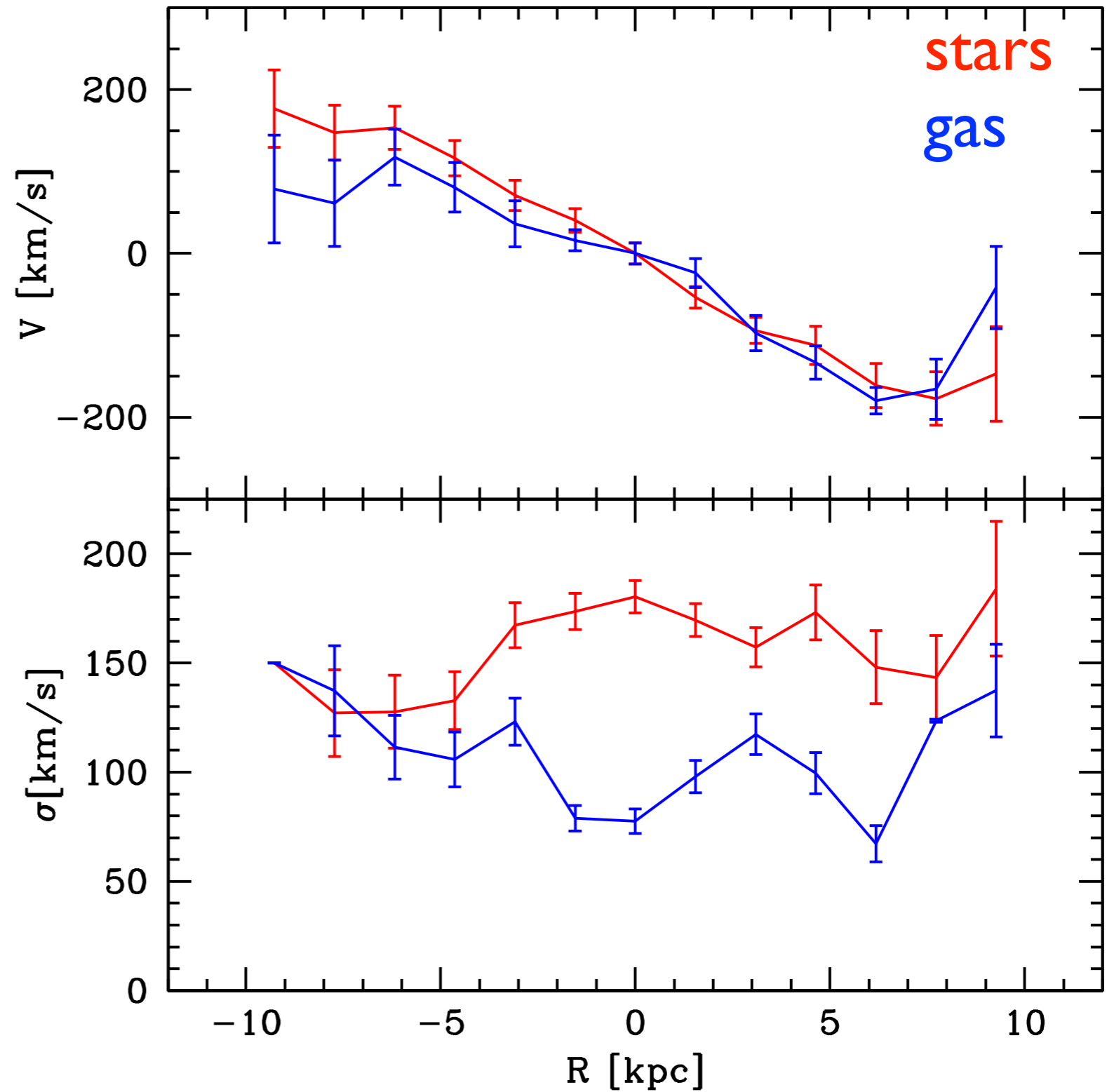


- Down-sizing at $z \sim 1$
- Star-forming galaxies at $z \sim 0.6-1$ are in the middle of their main formation phase
- Mass weighted ages of most massive $z \sim 0.8$ quiescent galaxies are 5 Gyr

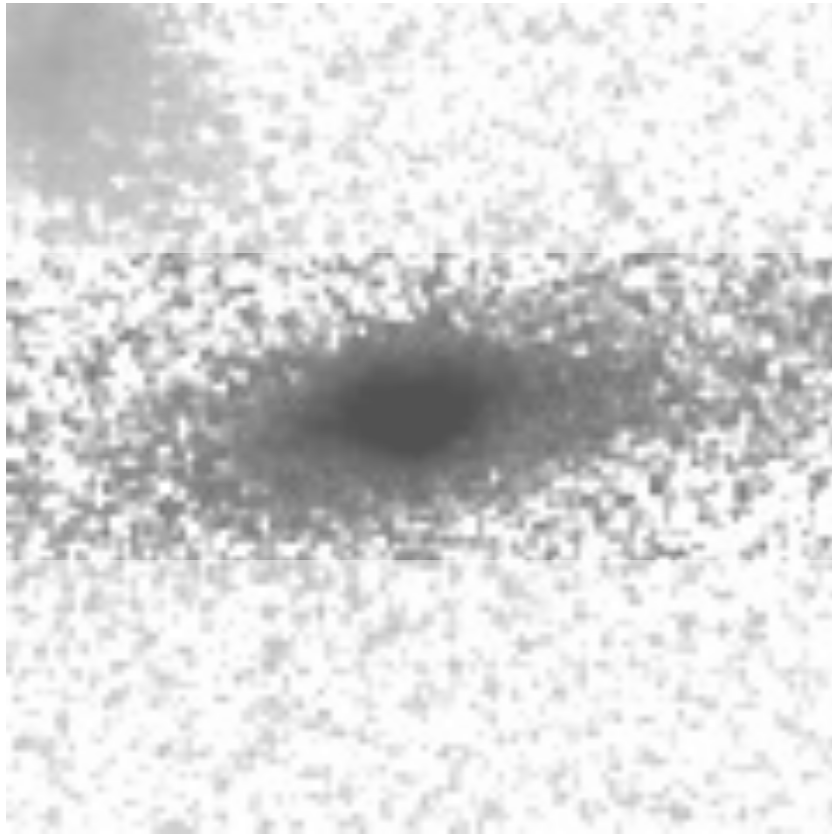
Spatially Resolved Kinematics



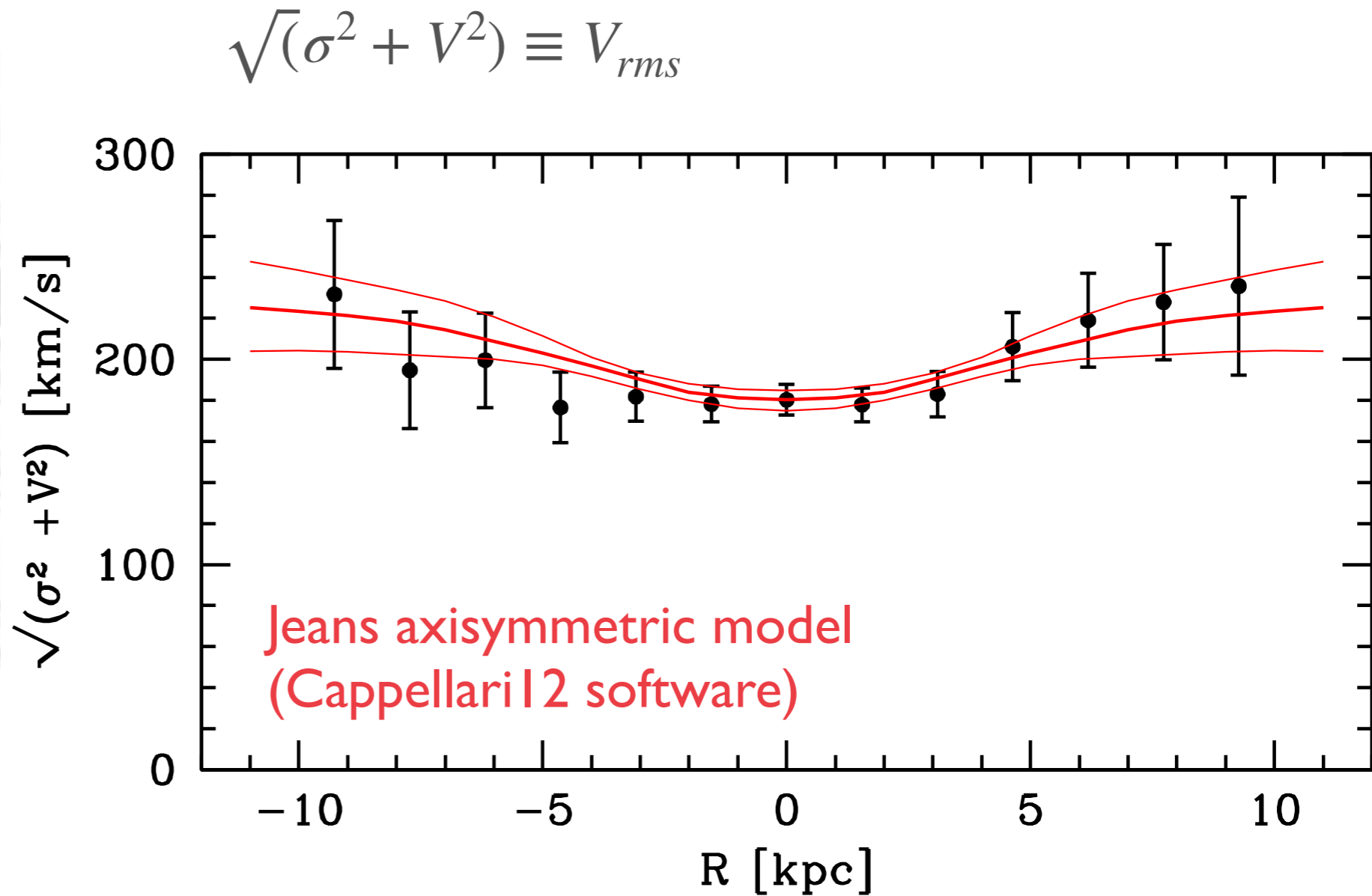
$z = 0.75$
 $M_{\text{star}} = 9 \times 10^{10} M_{\text{sol}}$
 $\text{SFR} = 6 M_{\text{sol}}/\text{yr}$



Jeans dynamical modeling



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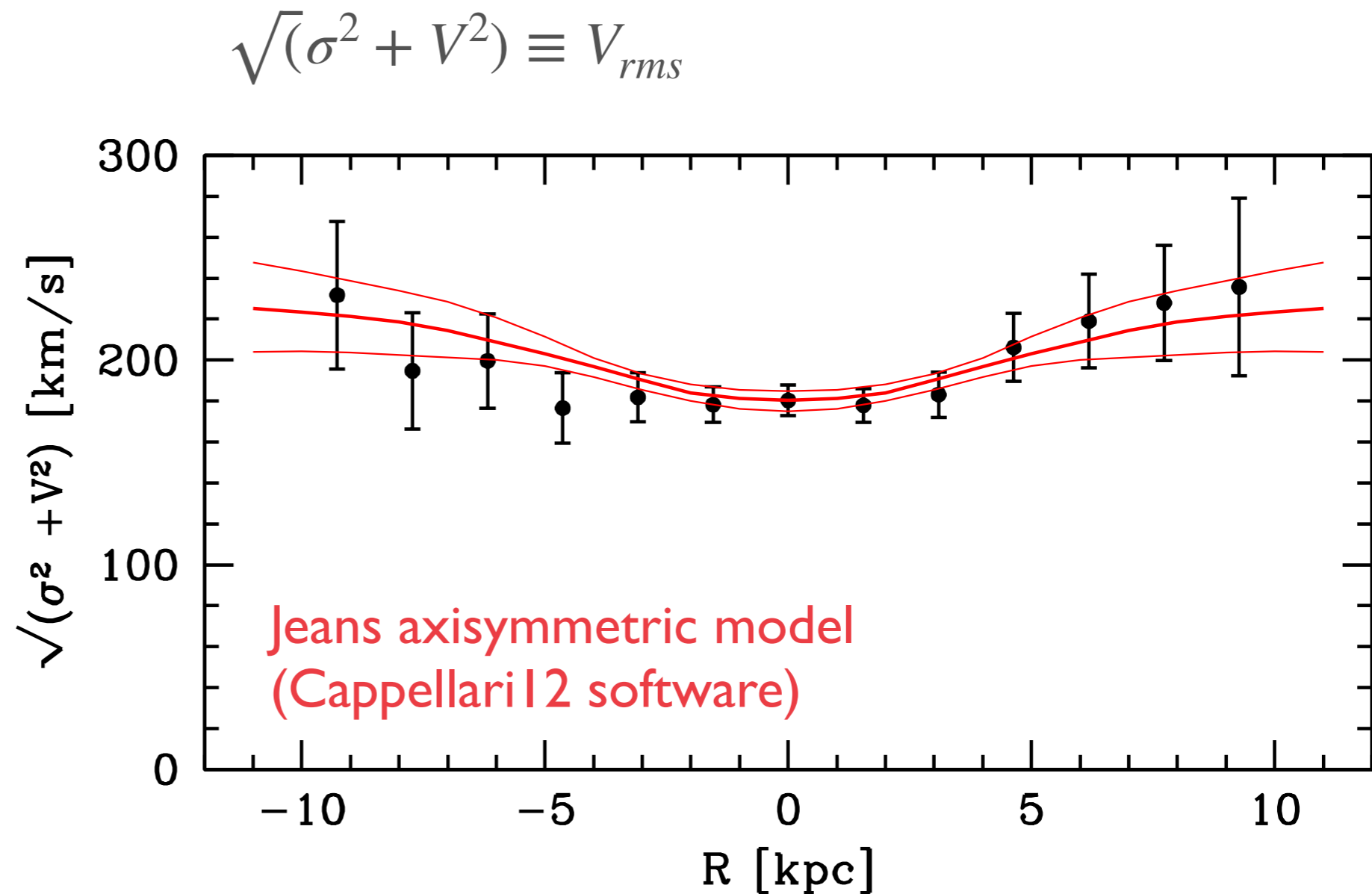


van Houdt, van der Wel et al. (in prep.)

Jeans dynamical modeling

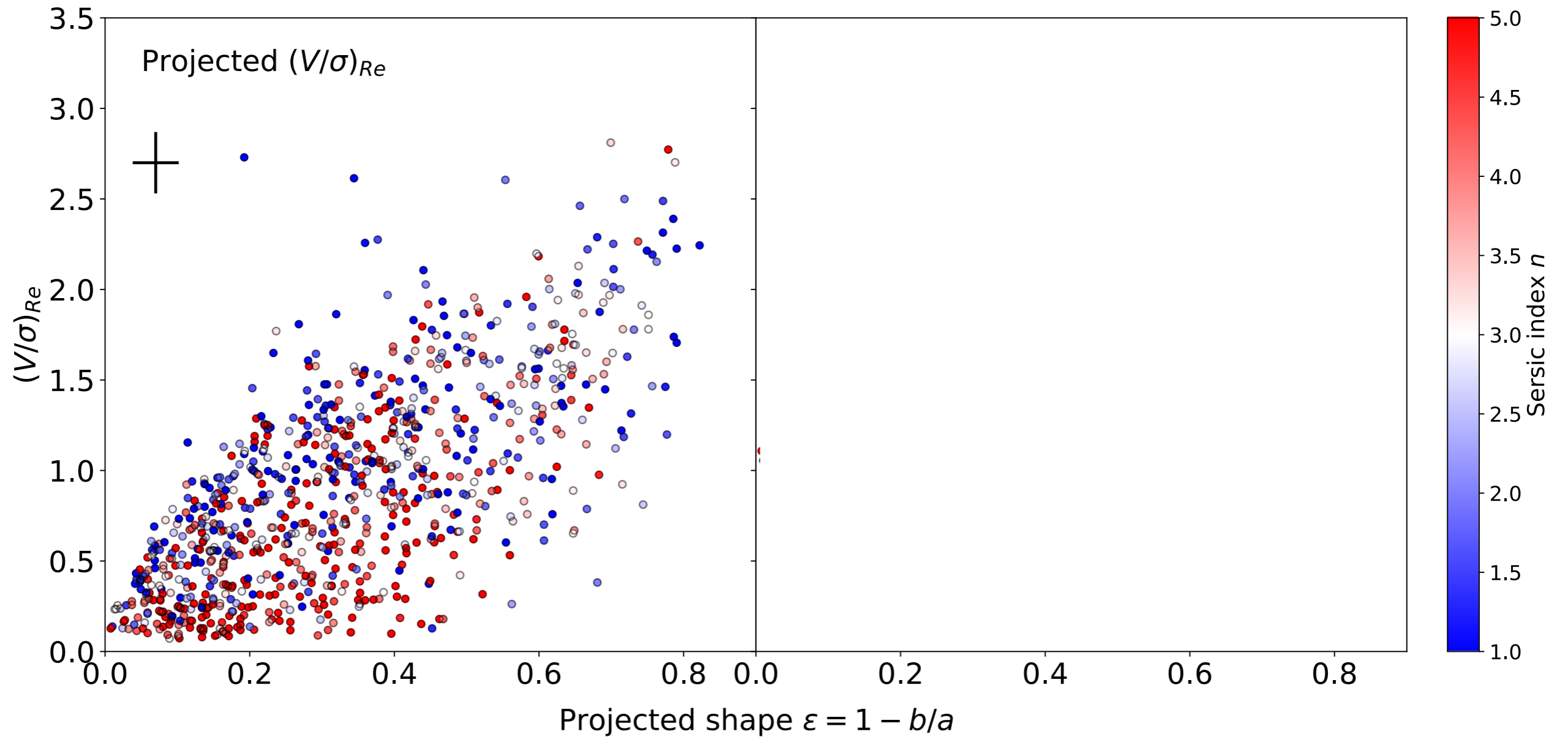
Free parameters:

- stellar M/L
- NFW halo
- Inclination
- Anisotropy



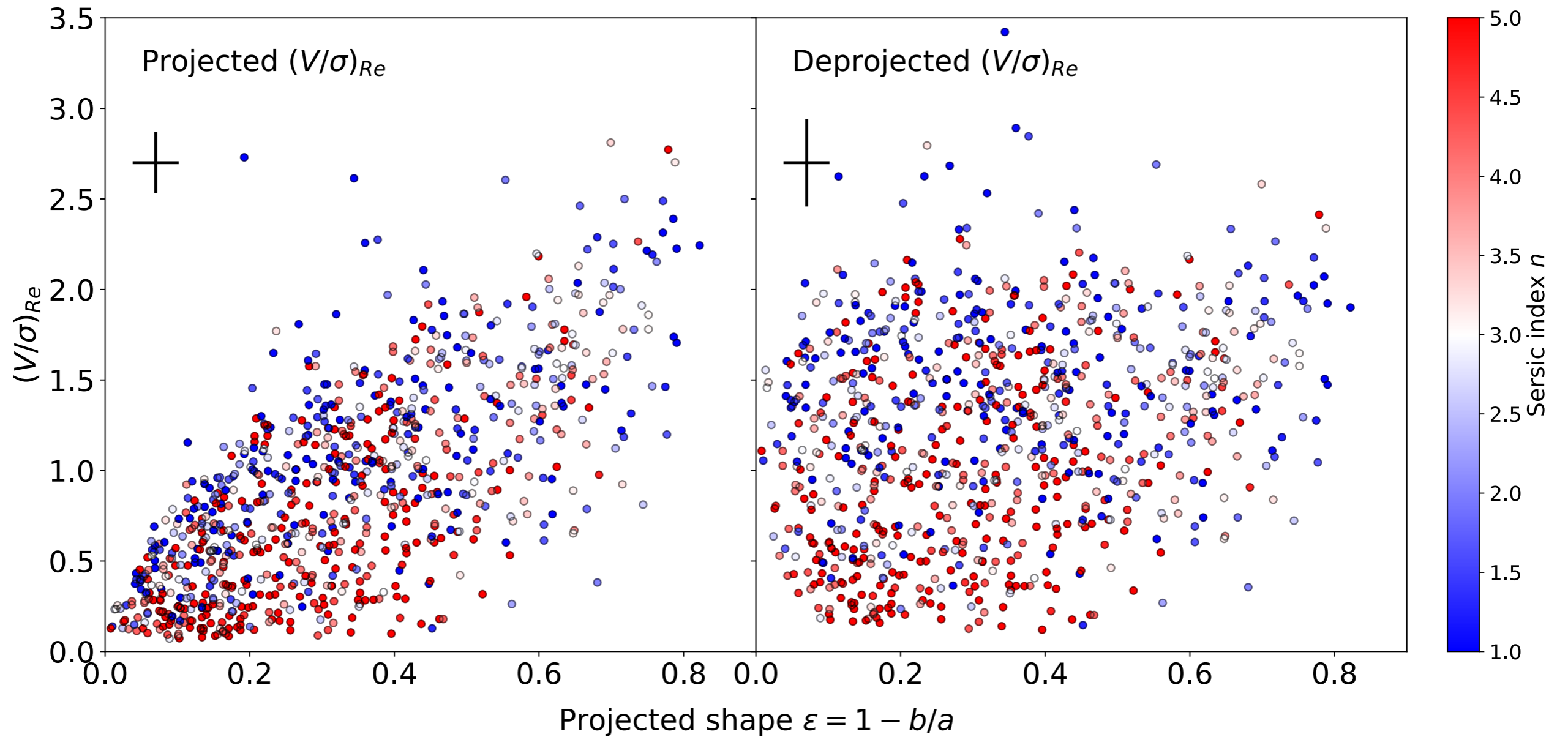
van Houdt, van der Wel et al. (in prep.)

Stellar Dynamical Structure at $z=0.6-1$



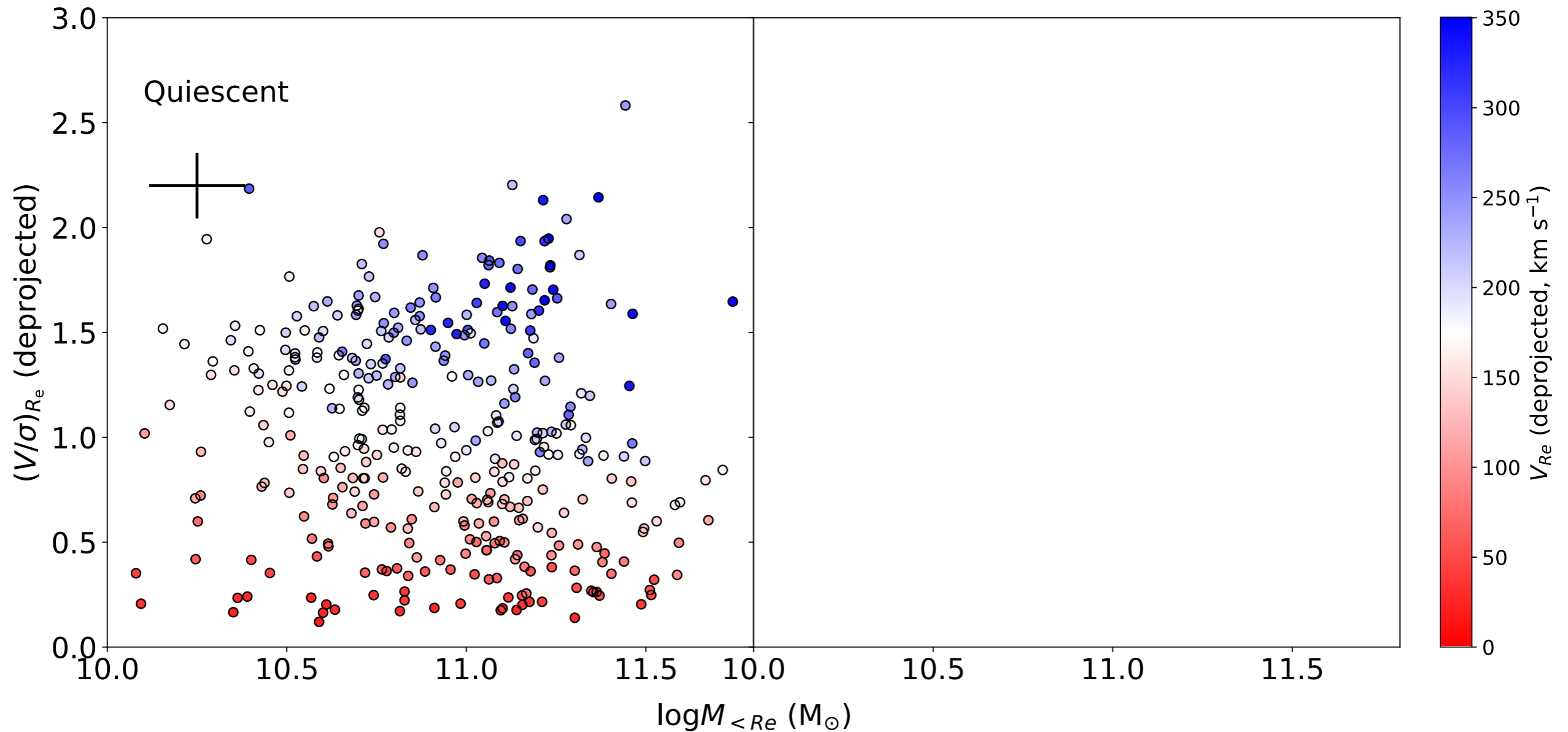
- Spatial structure (round shape and high Sersic index) is a weak proxy for lack of rotation
- Star-forming galaxies are oblate rotators

Stellar Dynamical Structure at $z=0.6-1$



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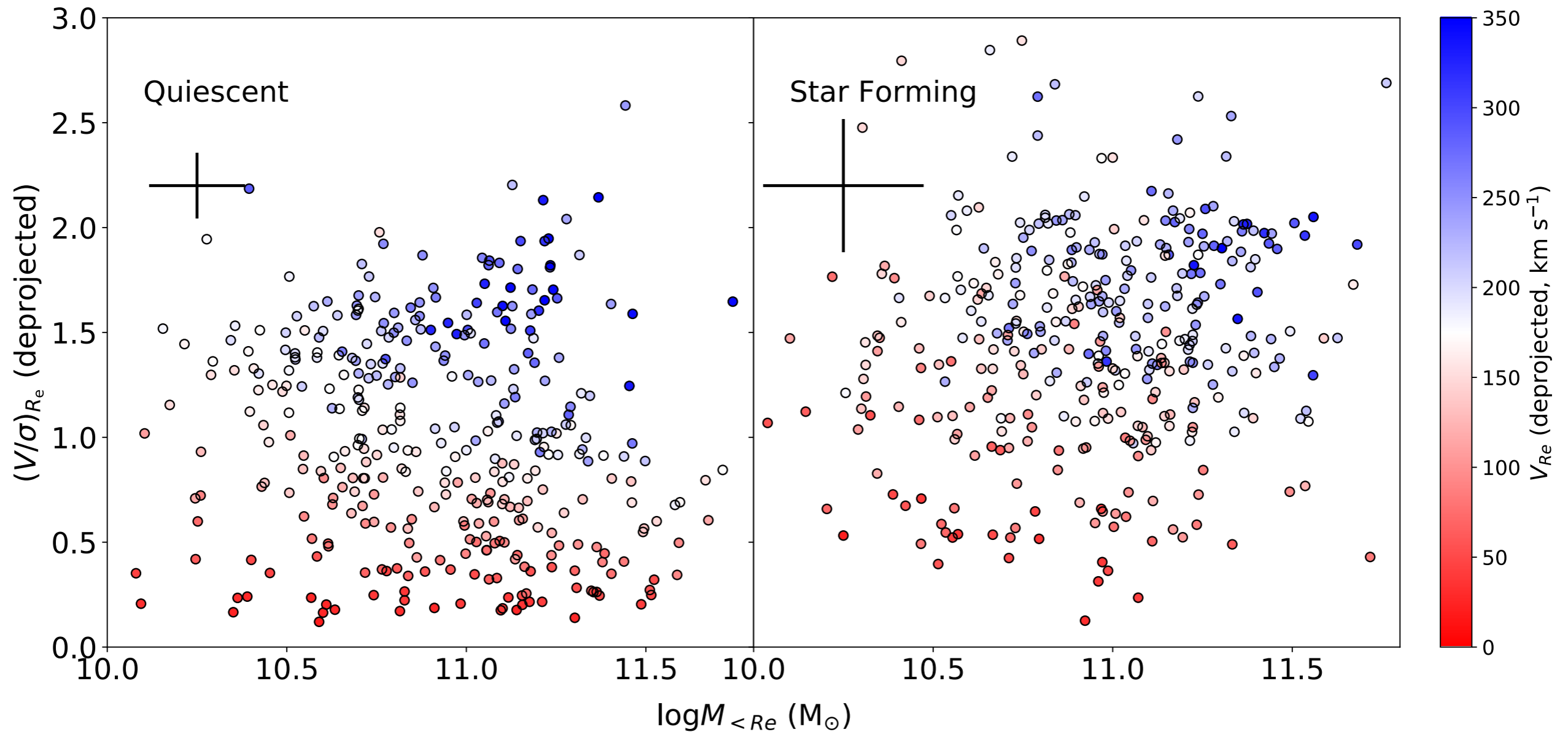
Dynamical Structure



- Mass and dynamical structure are weak proxies for star-formation activity
- The fastest rotating galaxies are quiescent

van Houdt, van der Wel et al. (in prep.)

Dynamical Structure



- Mass and dynamical structure are weak proxies for star-formation activity
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van Houdt, van der Wel et al. (in prep.)

Concluding Remarks

- LEGA-C: first probe at $z > 0$ of
 - Stellar populations
 - Stellar kinematics
- Third Data Release coming soon (May 2021)
- Stay tuned for LEGA-C contributions by
 - Francesco D'Eugenio
 - Tania Barone
 - Po-Feng Wu
 - Anna de Graaff