Stellar velocity dispersion of a massive galaxy with suppressed star formation at z=4.01

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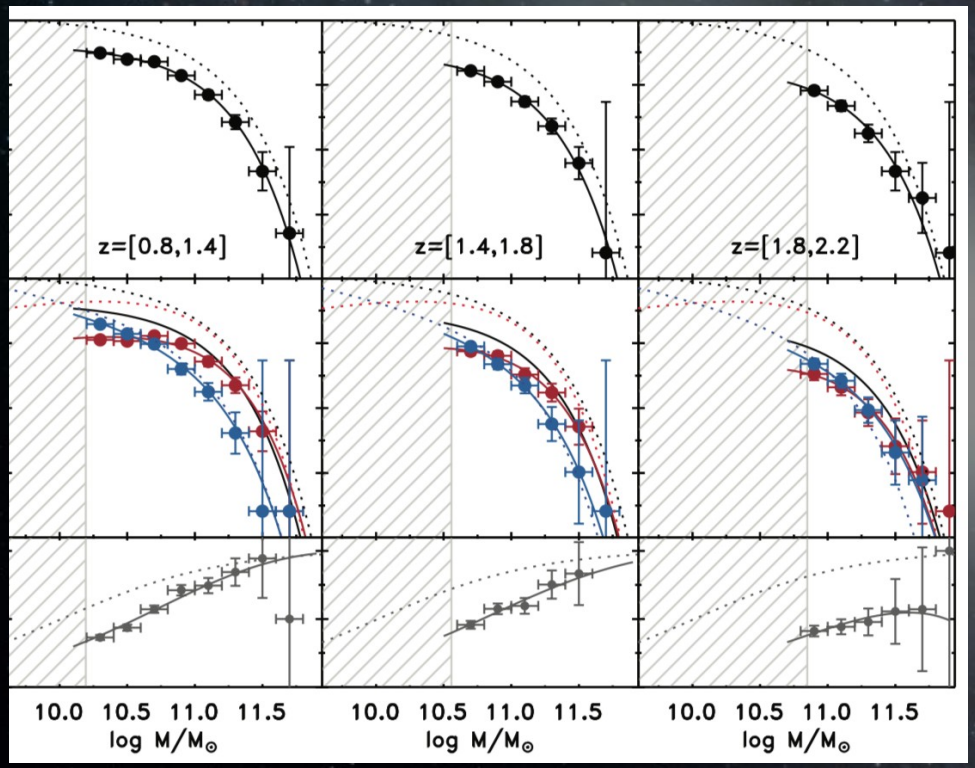
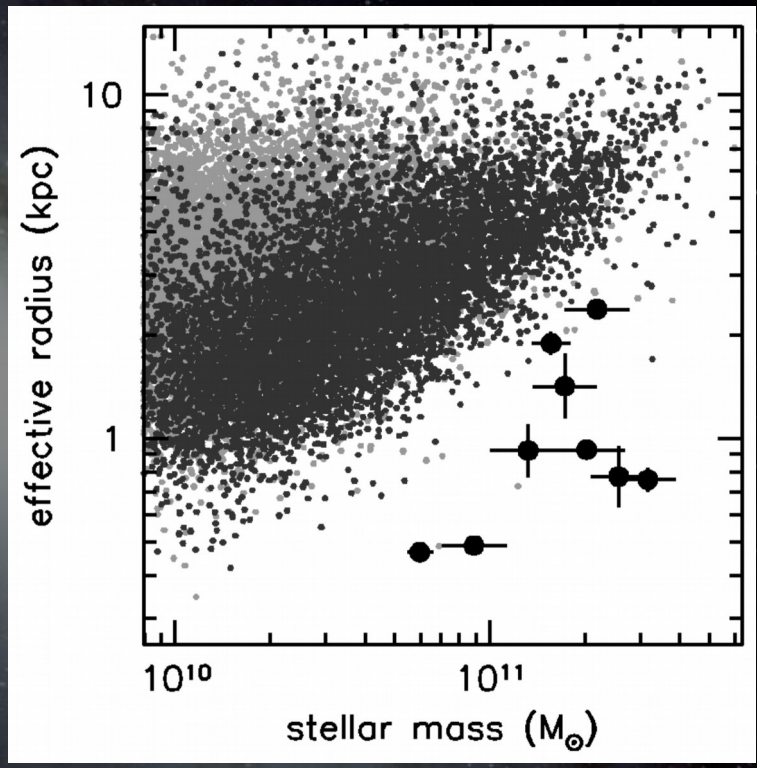
(IPMU) Kiyoto Yabe

Massive quiescent galaxies at high redshifts

Brammer+11

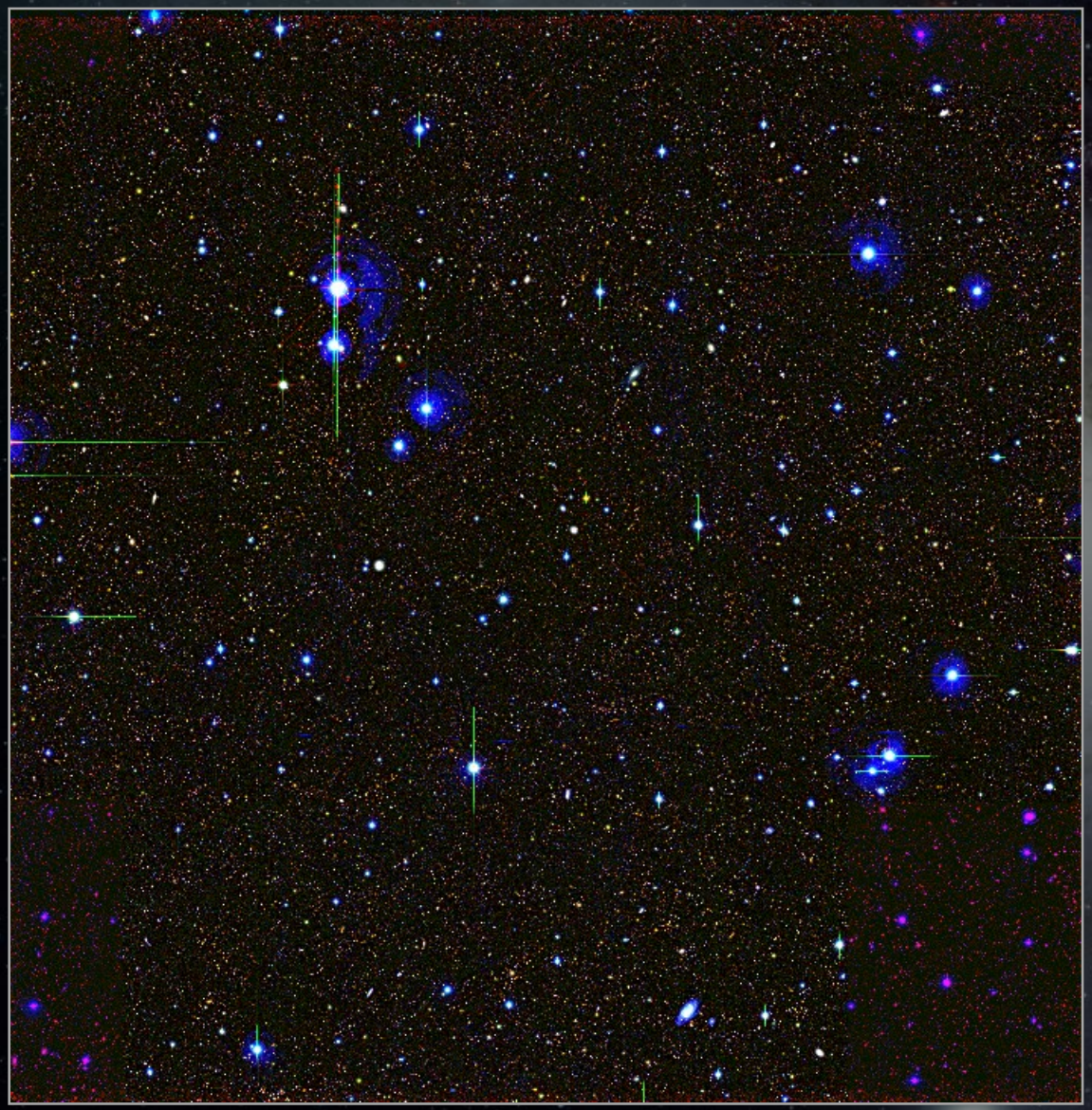


van Dokkum+09



~50% of the massive galaxies at z~2 are compact and quiescent.

Deep Multi-Wavelength Data in SXDS

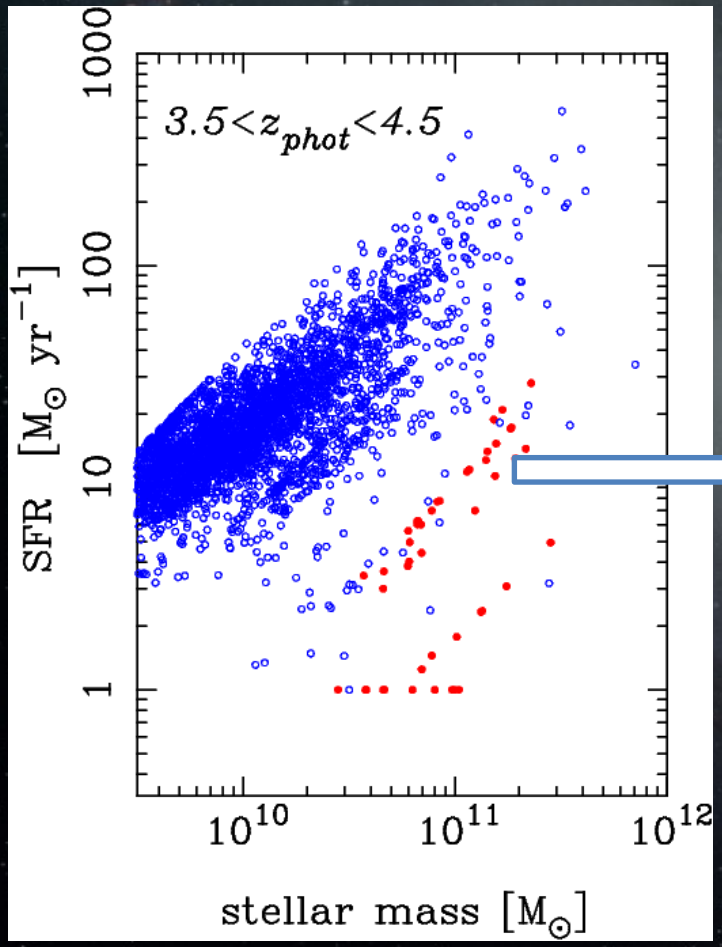


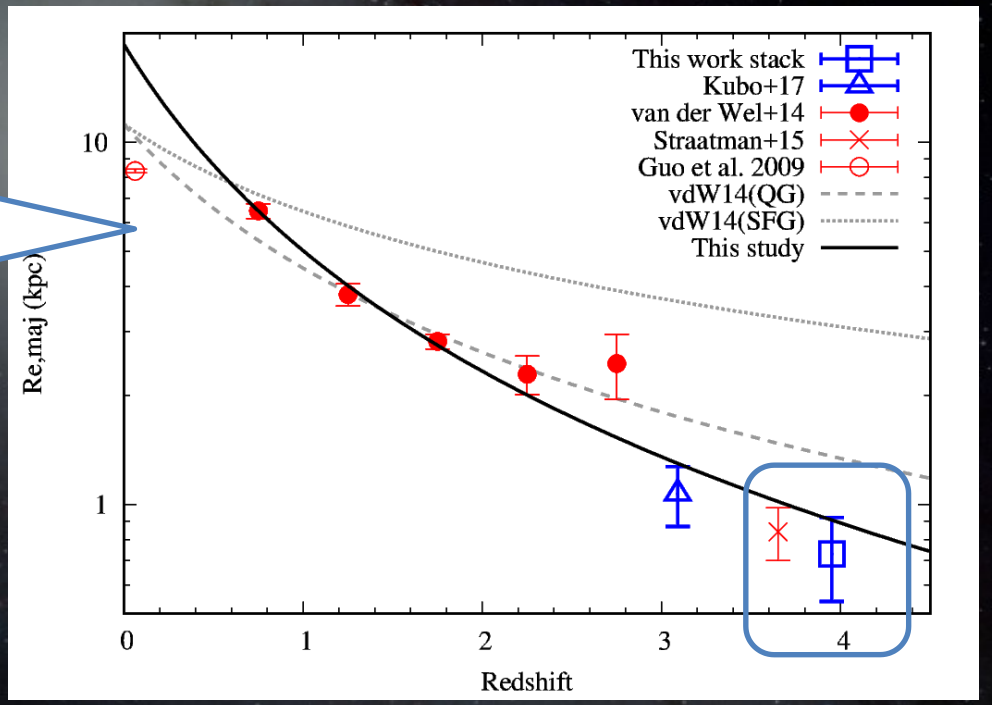
BzK composite

u:	26.8
B:	27.6
V:	27.3
R:	27.1
i:	27.0
z:	26.0
J:	25.2
H:	24.6
K:	25.0
[3.6]:	24.8
[4.5]:	24.3
[6.5]:	22.6
[8.0]:	22.5

5sigma in 2” aperture

Massive quiescent galaxies at z~4

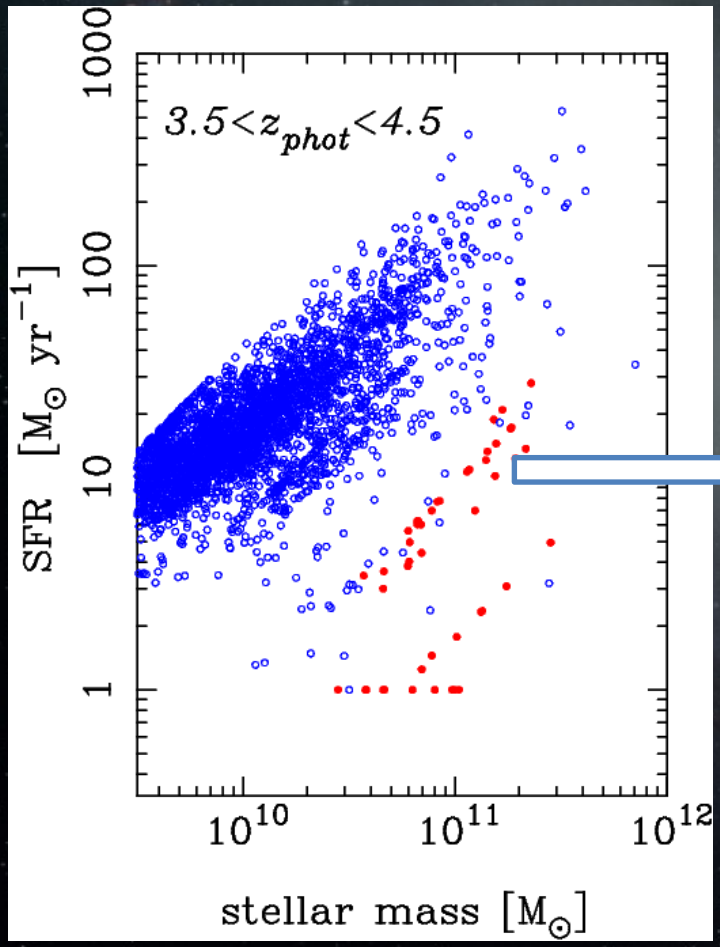


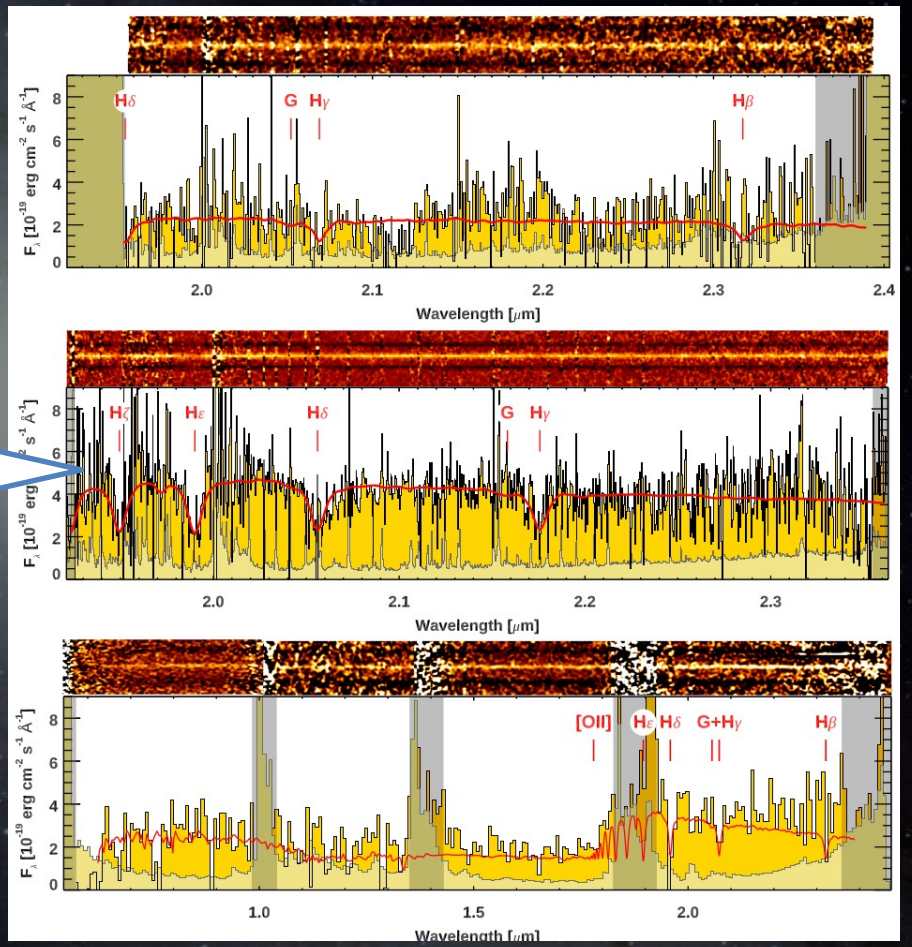


Quiescent: sSFR<10^-9.5 yr^-1

Kubo, MT, et al. 2018

Massive quiescent galaxies at z~4

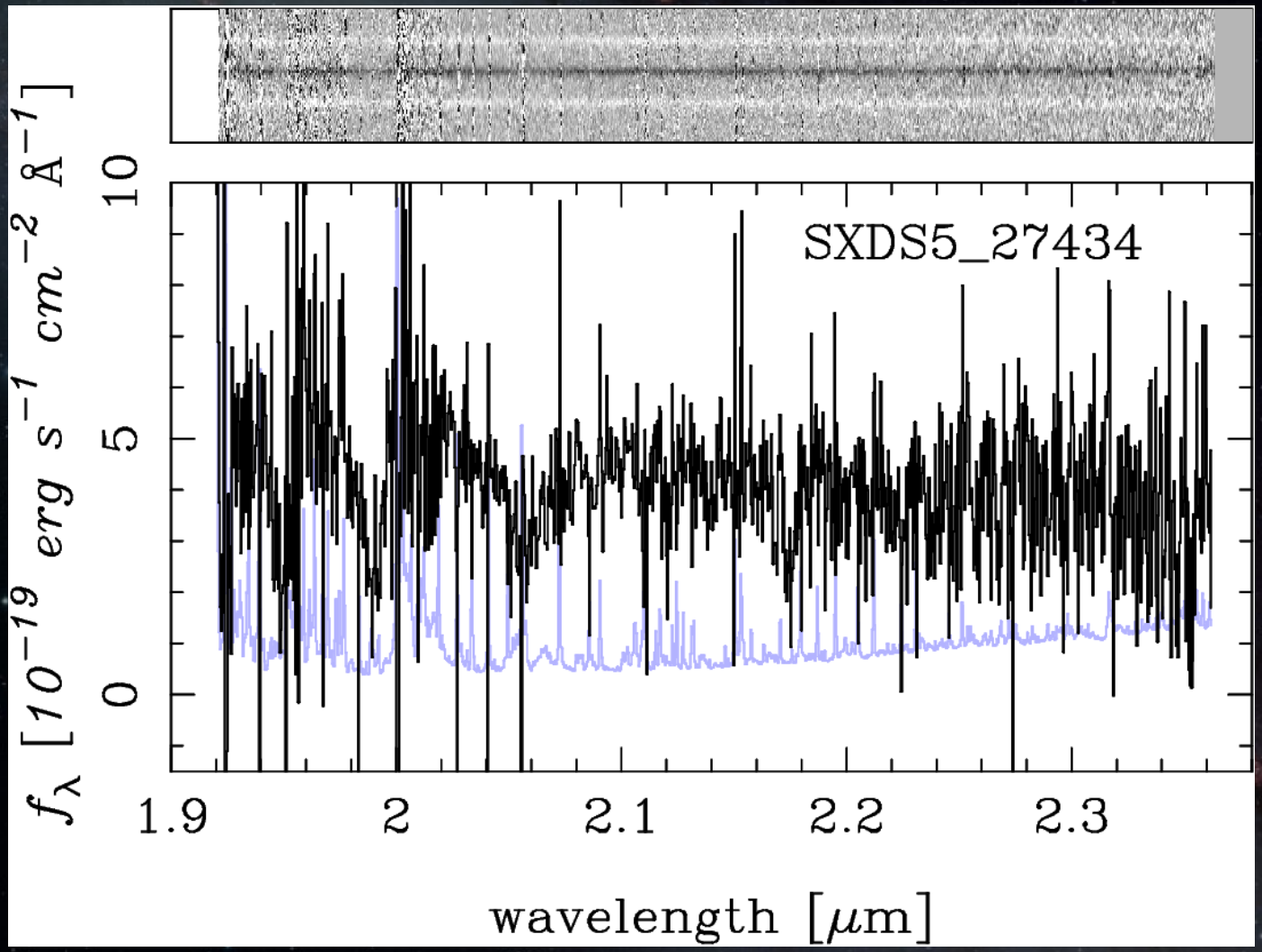




Quiescent: sSFR<10^-9.5 yr^-1

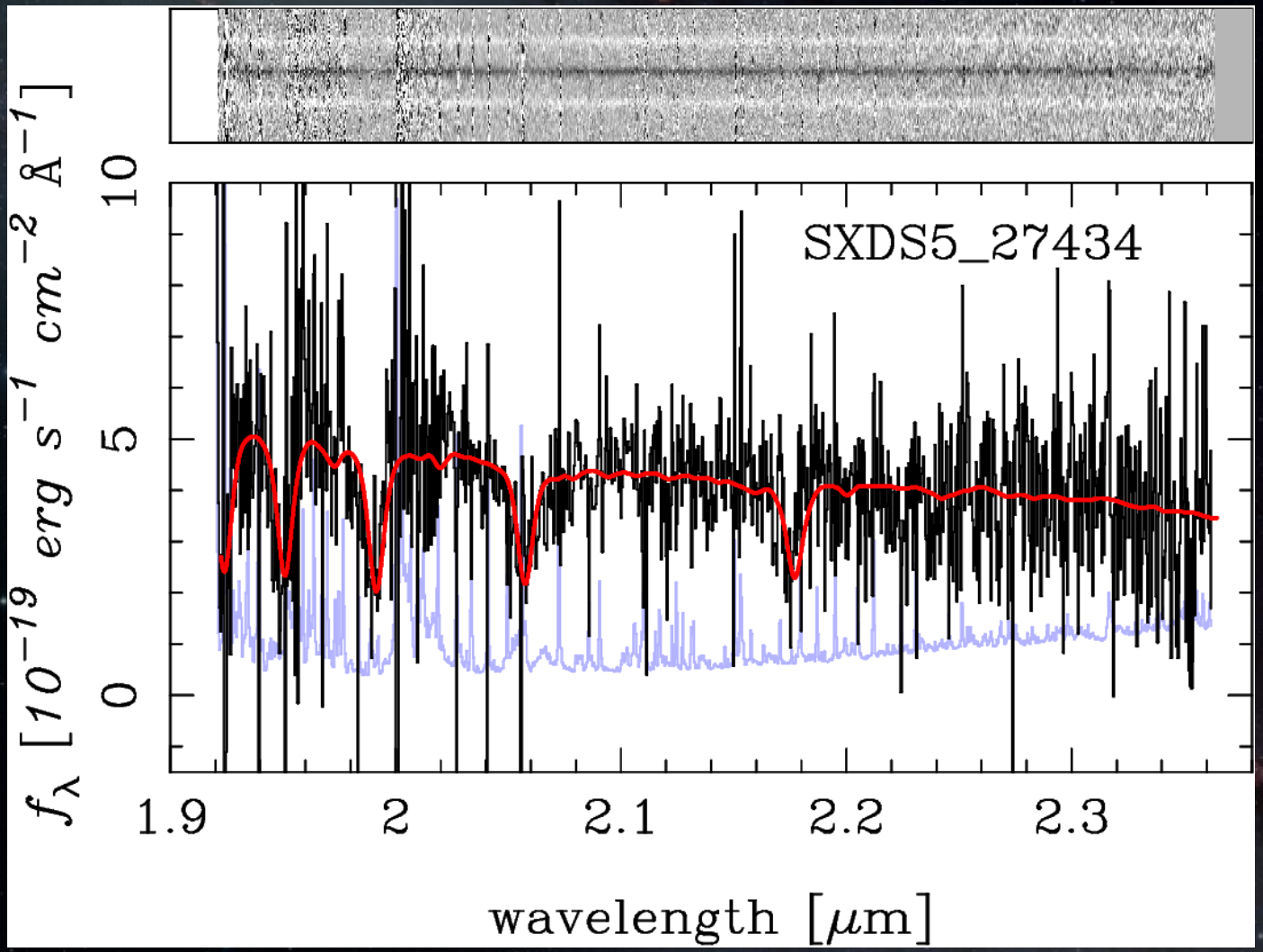
Valentino et al. 2019 ApJ submitted

MOSFIRE spectrum



~7 hour integration with MOSFIRE (Tanaka+ 2019, ApJ,885, L34)

MOSFIRE spectrum



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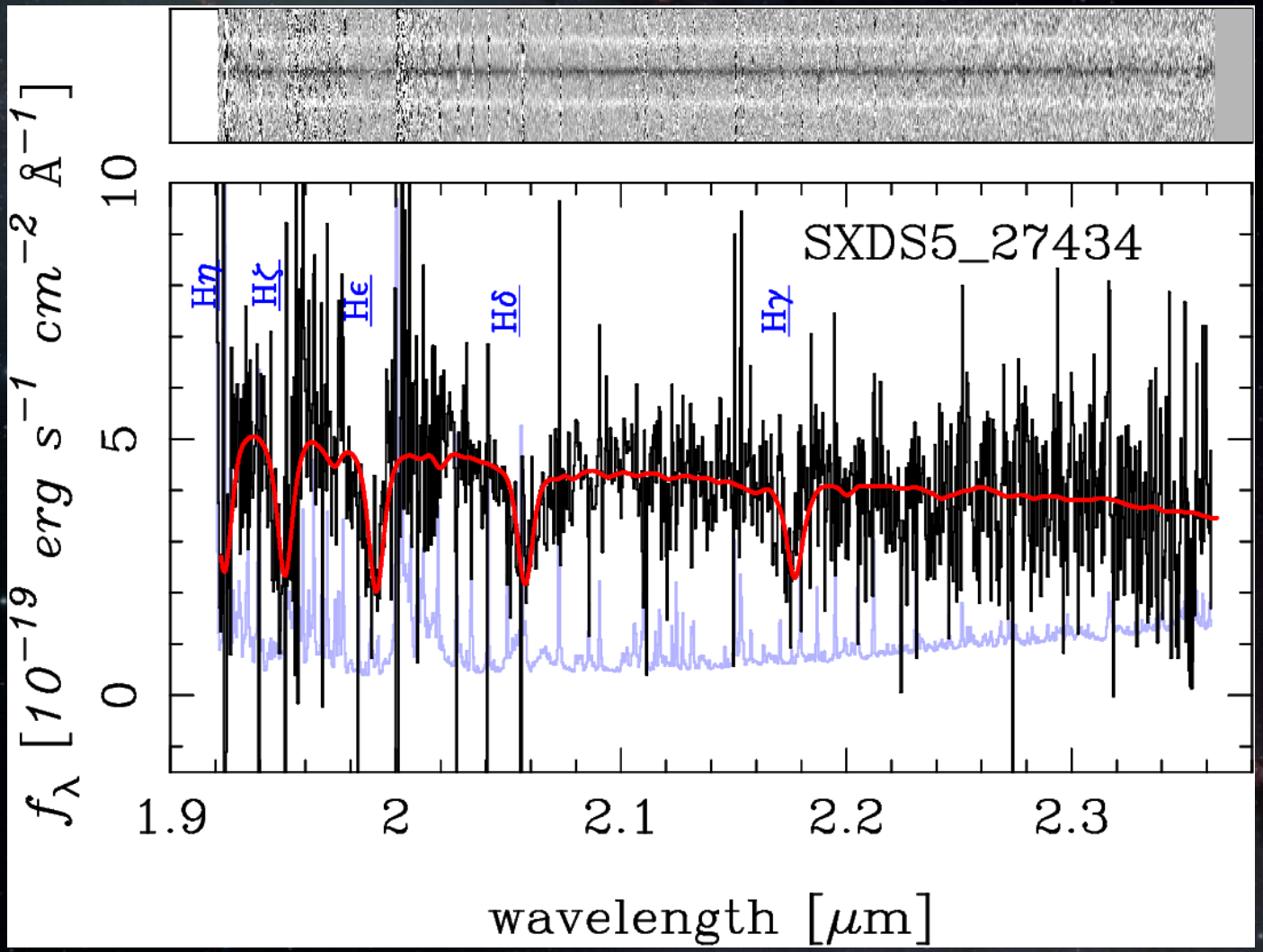
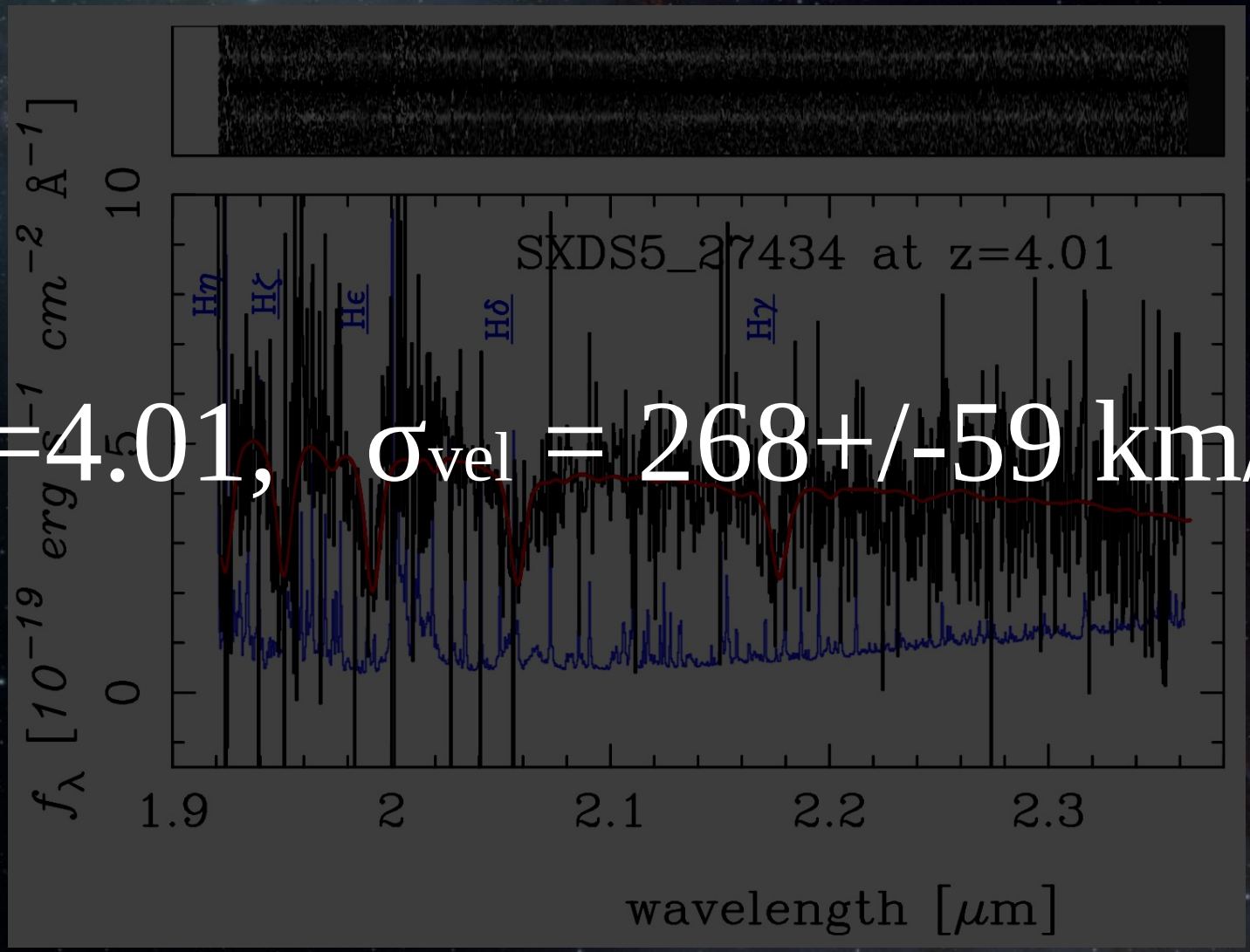
MOSFIRE spectrum



~7 hour integration with MOSFIRE (Tanaka+ 2019, ApJ,885, L34)

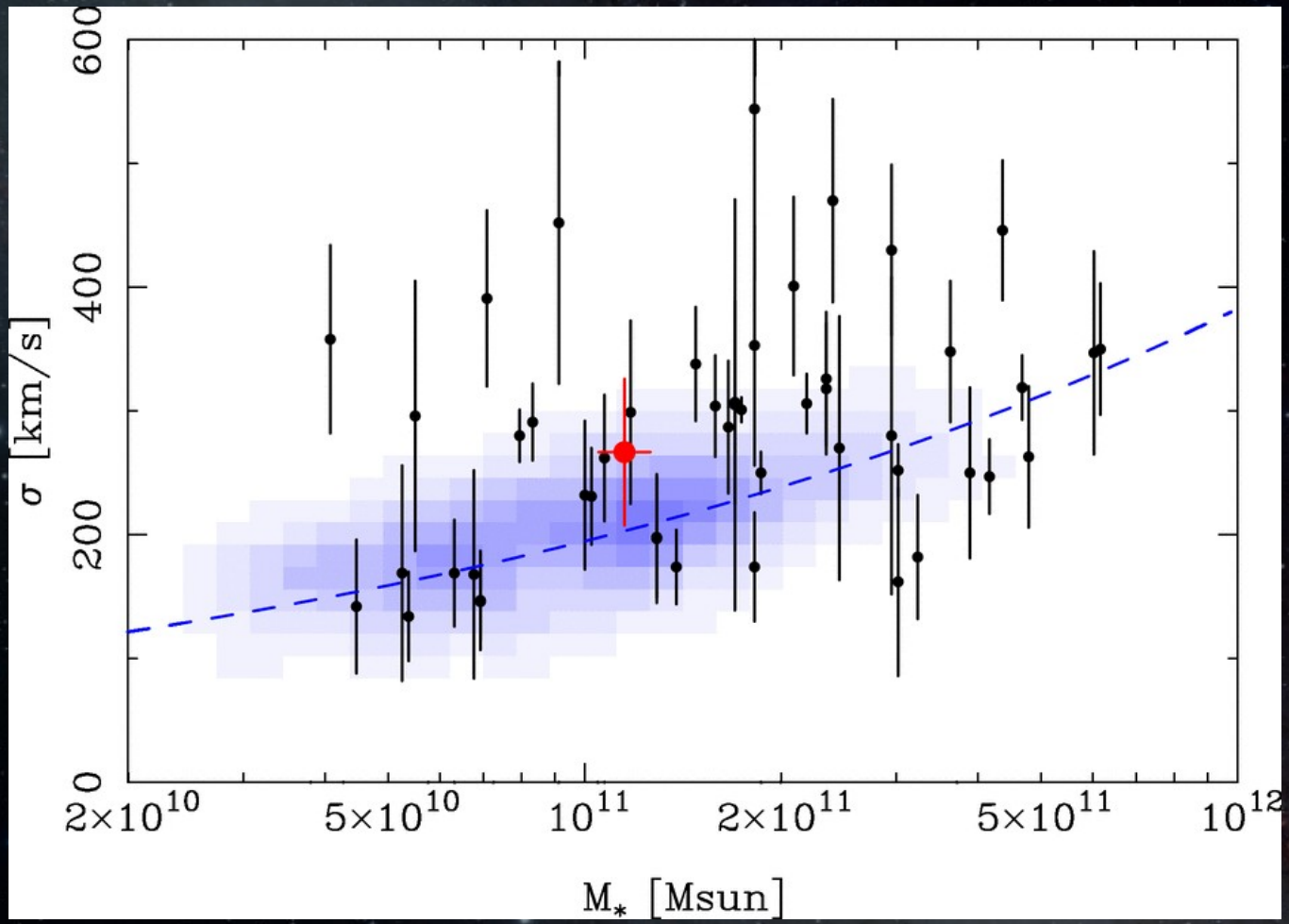
MOSFIRE spectrum



z=4.01, σ_{vel} = 268+/-59 km/s

~7 hour integration with MOSFIRE (Tanaka+ to be submitted soon)

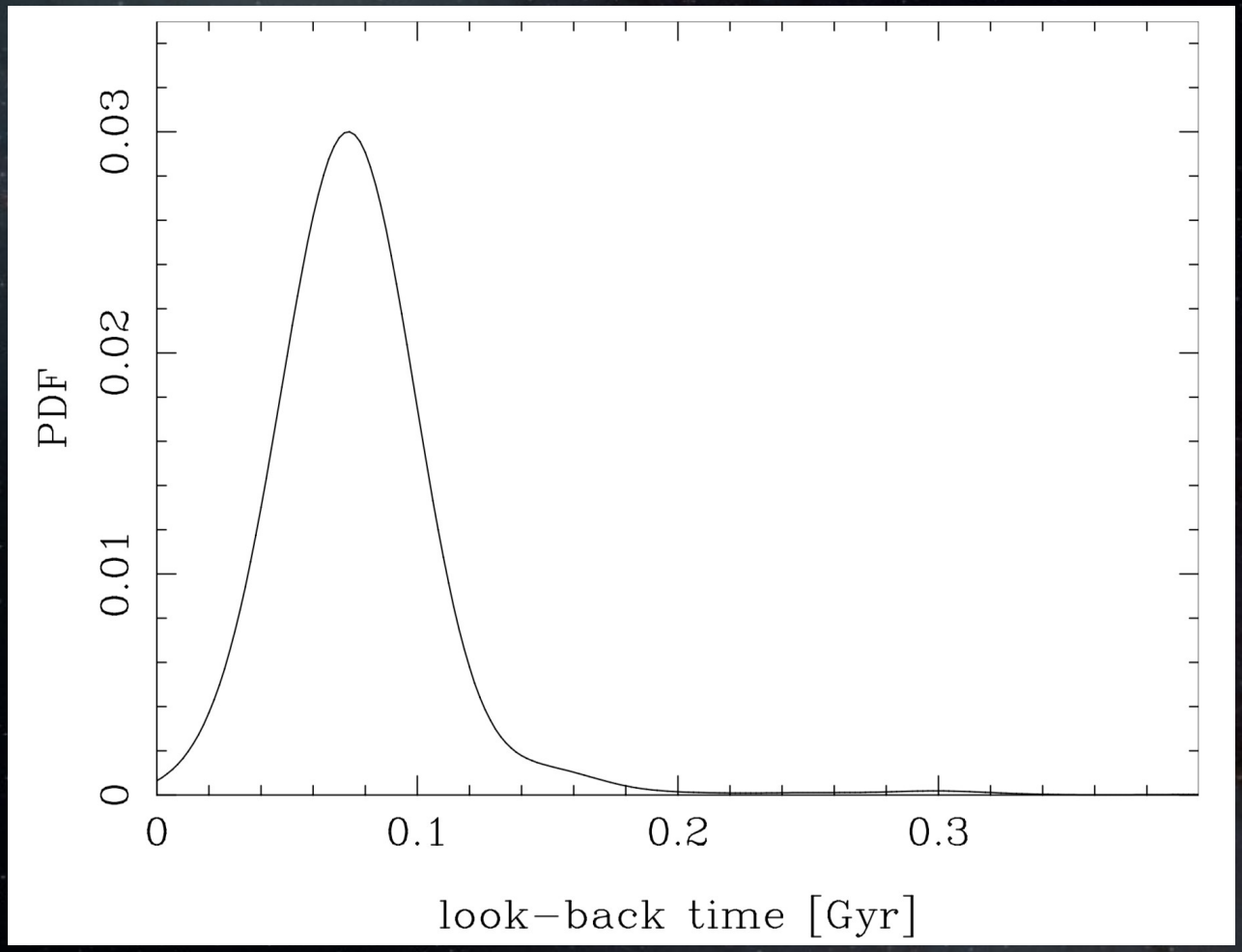
Massive quiescent galaxies at z=4



z=4 z~2 z~0.7 (LEGA-C) z=0

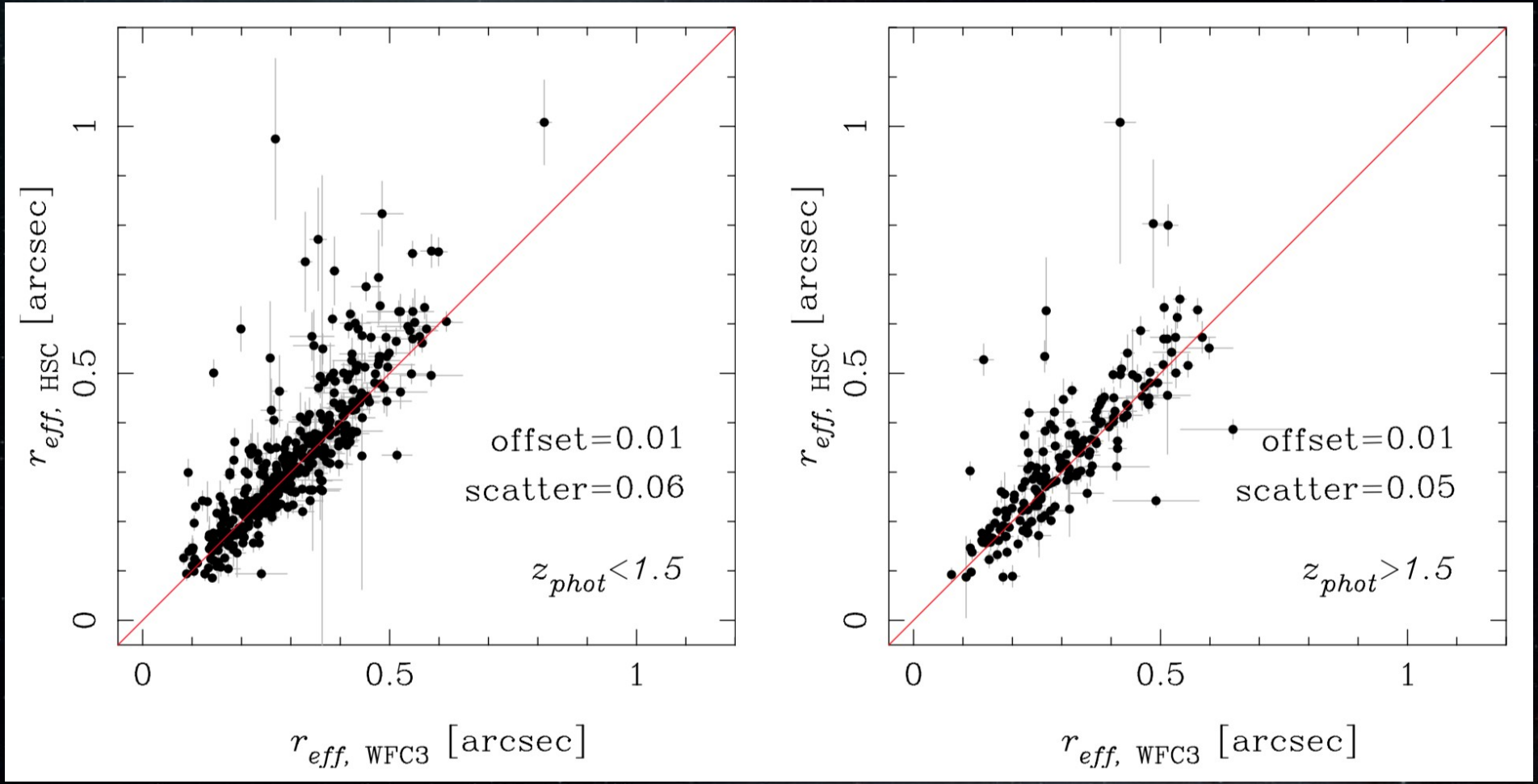
Stellar velocity dispersion does not significantly evolve over the last 12 Gyr

Star formation history



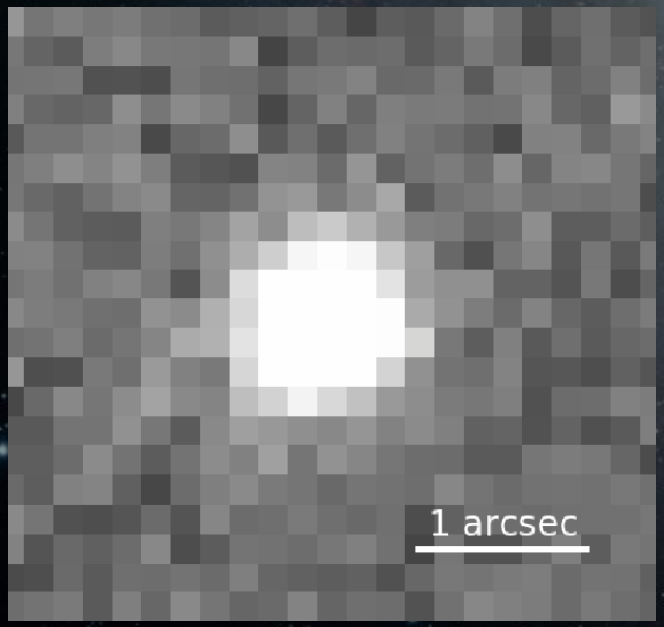
SFH from pPXF (age distribution of the SSP templates contributed to the best-fit spectrum). This is a ~~post-starburst~~ A-type galaxy.

Rest-frame UV sizes from HSC-SSP

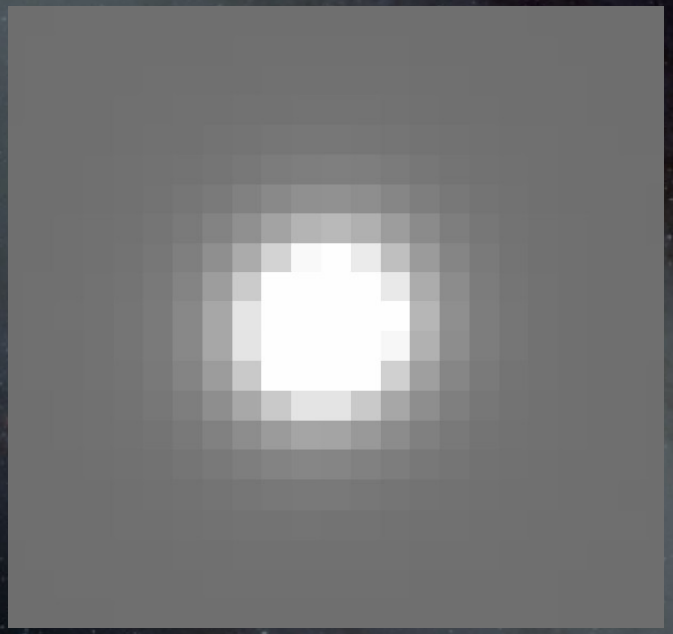


HSC-SSP is pretty good for constraining sizes.

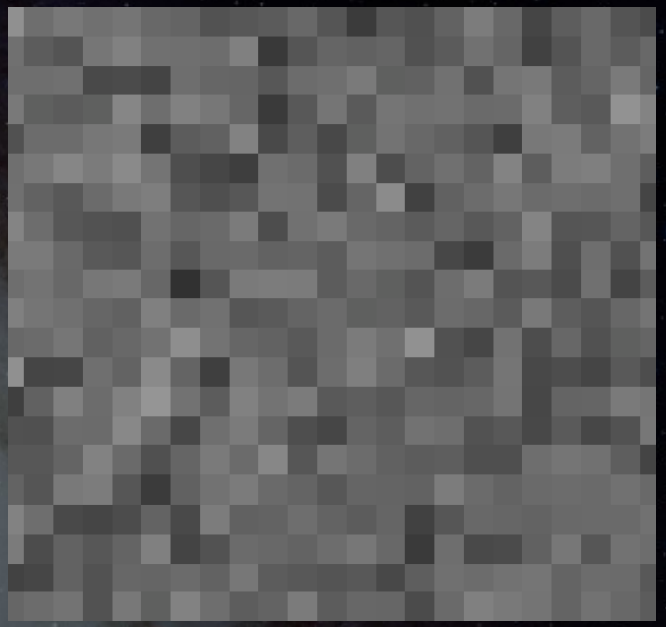
Rest-frame UV sizes from HSC-SSP



Original image



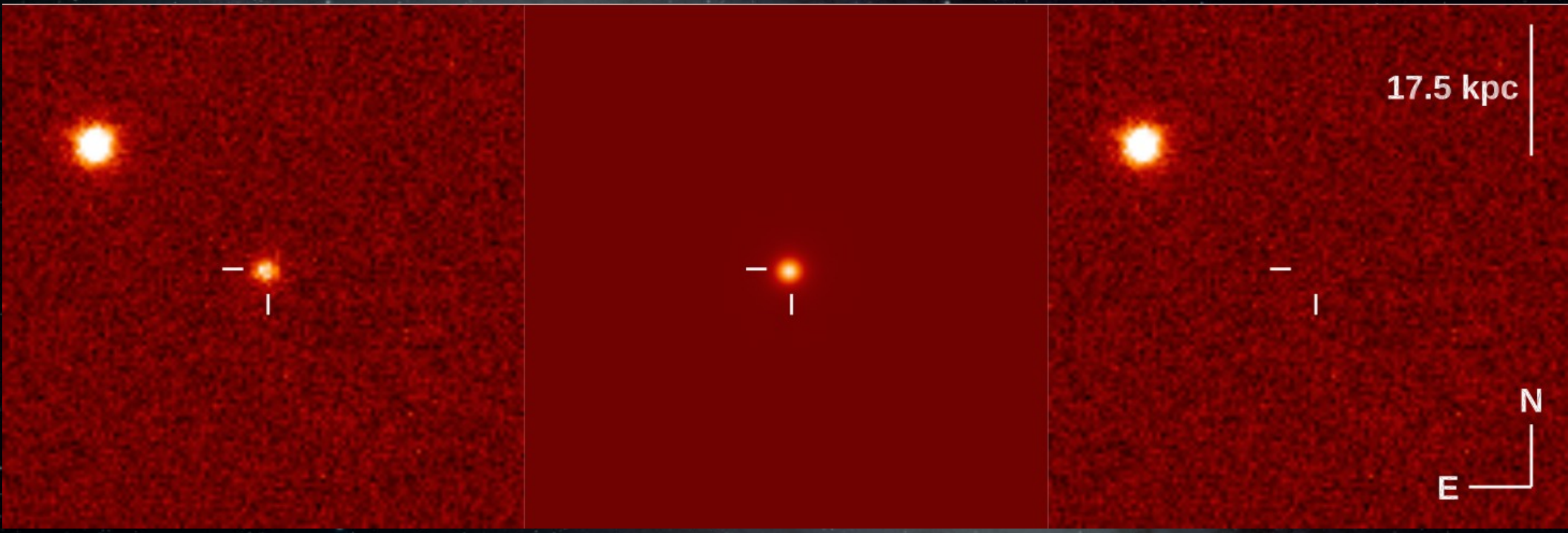
Best-fit model



Residual

The z=4 galaxy has r_eff = 0.76 +- 0.20 kpc

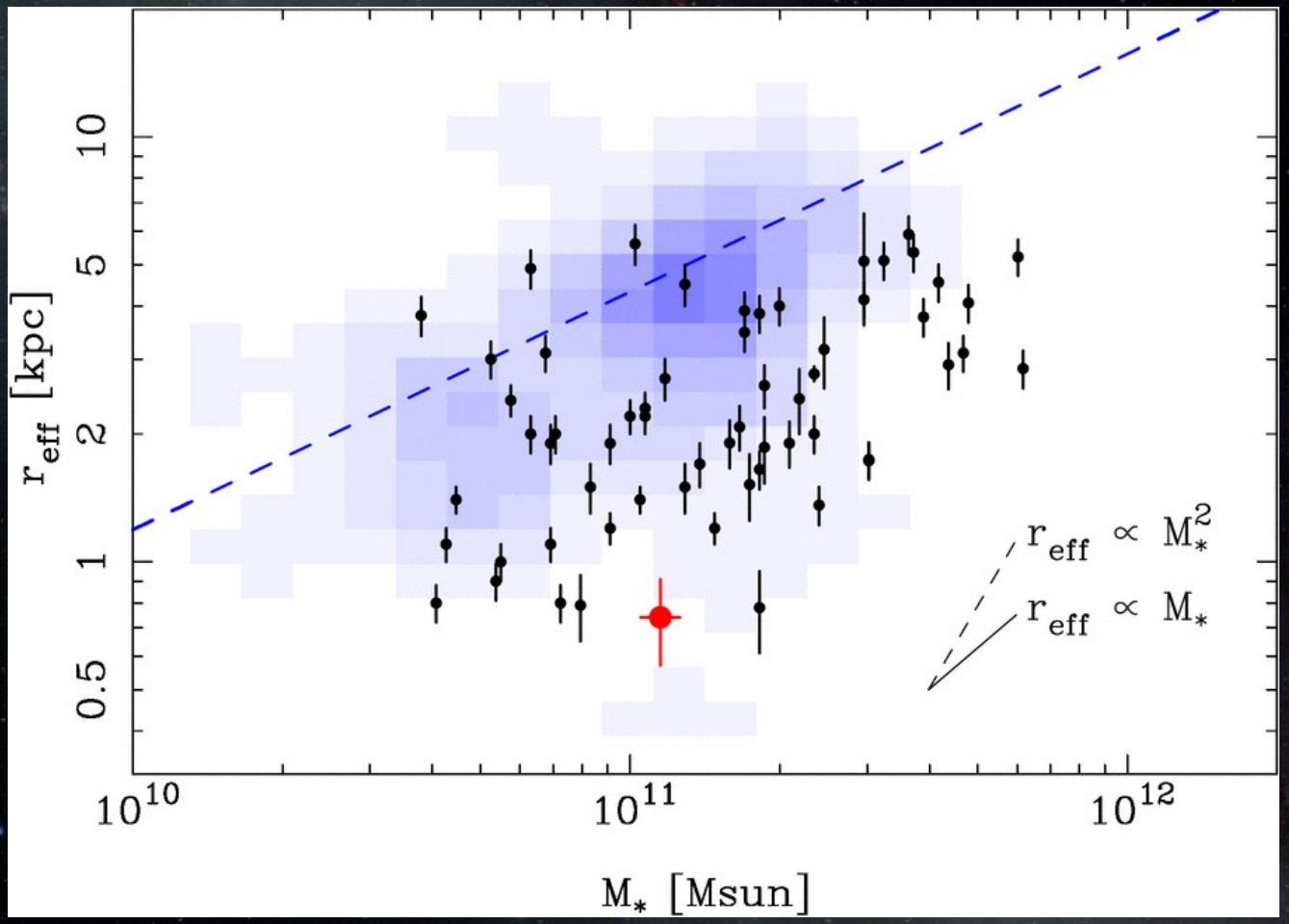
Rest-frame optical sizes from HAWK-I + GLAAL



Original image | Best-fit model | Residual

The z=4 galaxy has r_eff = 0.74 + 0.17 / -0.08 kpc

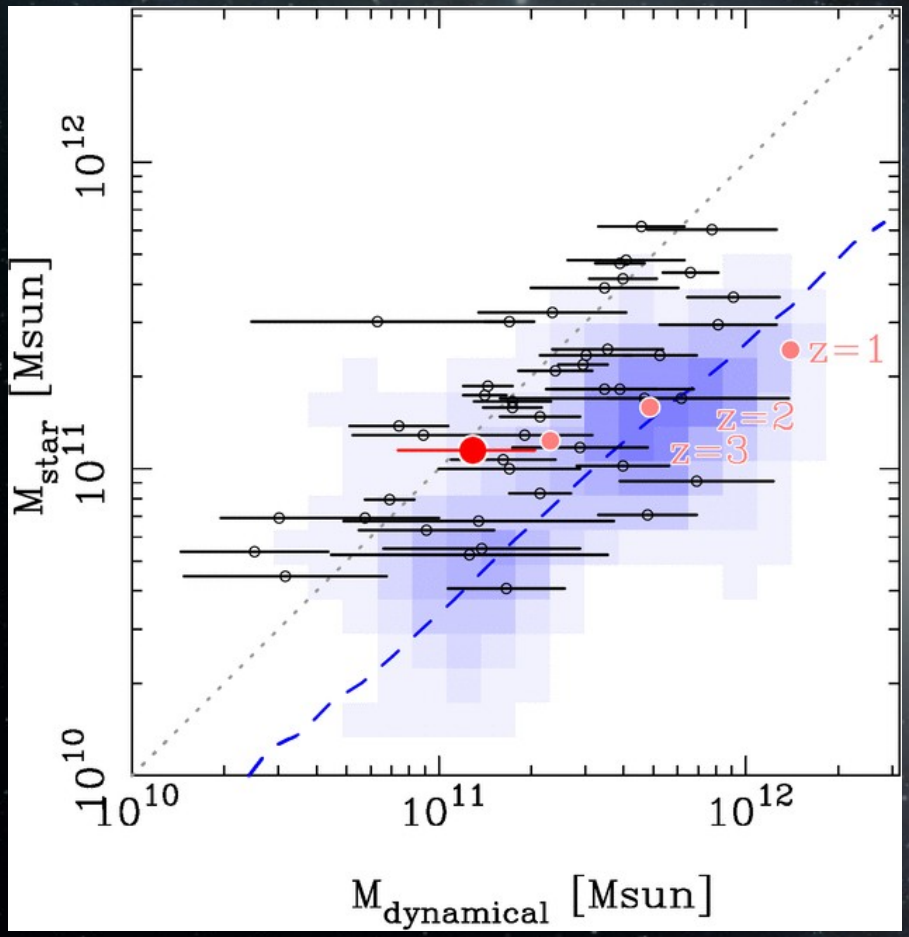
Size-Stellar Mass relation

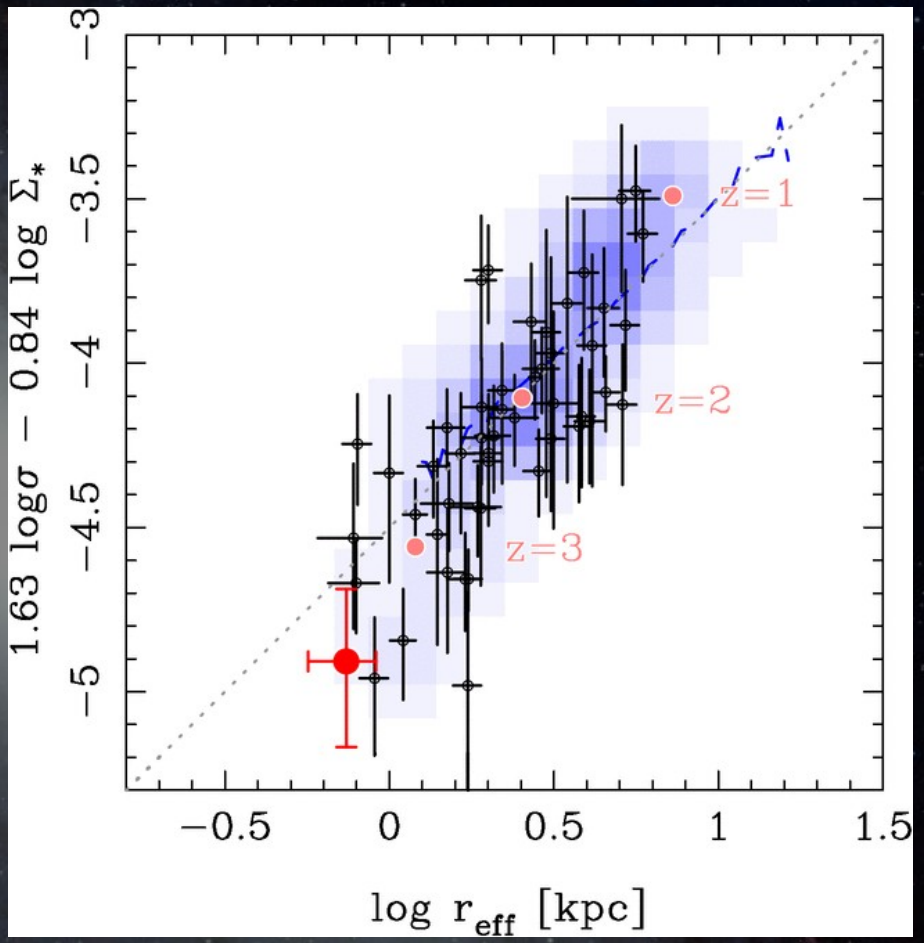


z=4 z~2 z~0.7 (LEGA-C) z=0

The z=4.01 object is compact for its mass. The size is consistent with the typical size of z~4 galaxies from Kubo+ 2019.

First Dynamical Analysis at z=4





z=4 z~2 z~0.7 (LEGA-C) z=0

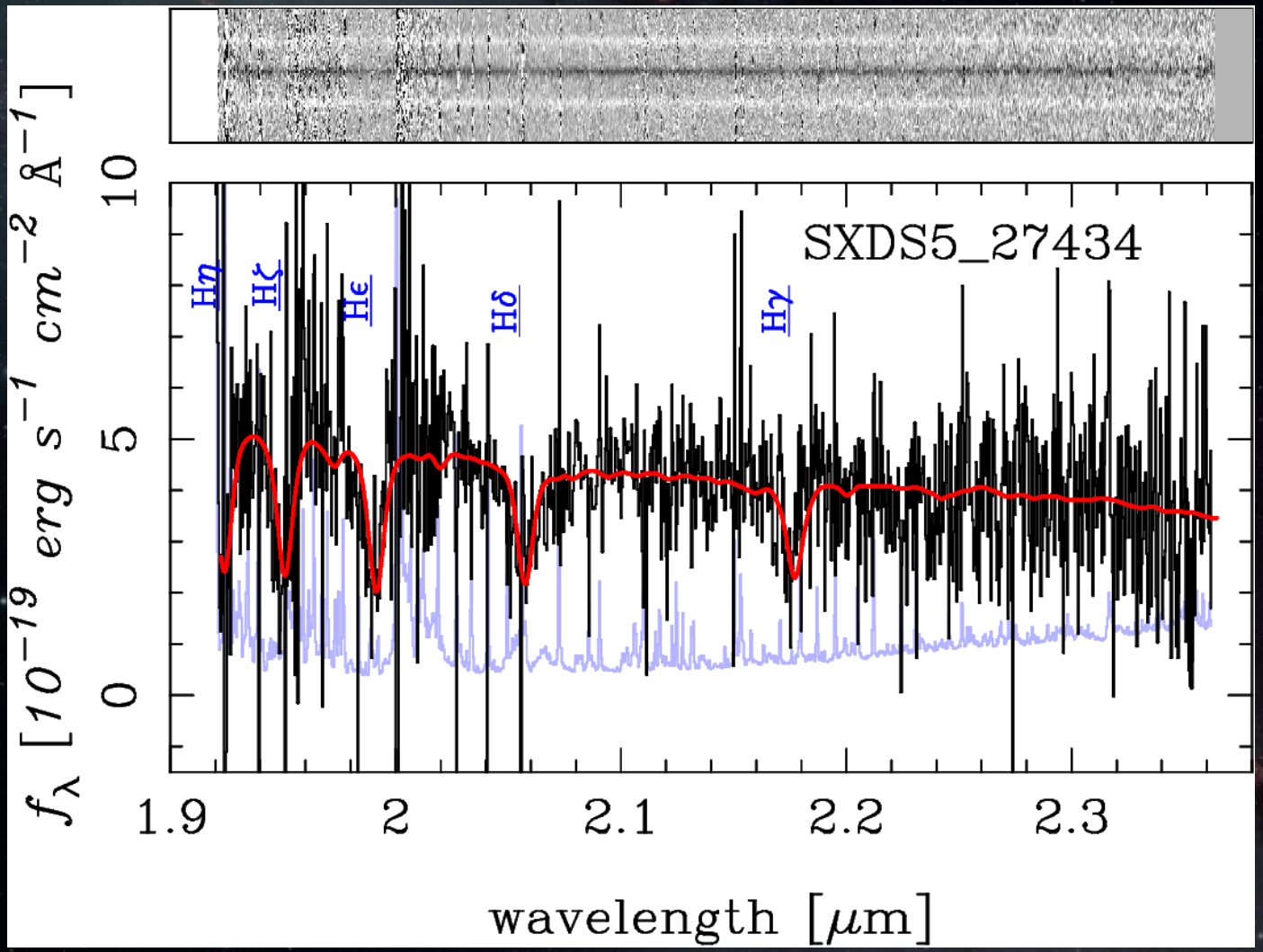
- The dynamical mass is consistent with the stellar mass from photometry.
- The z=4 object is on the mass fundamental plane.

Discussion and Summary

- We have confirmed the highest redshift quenching galaxy at z=4.01.
- We made the first measurement of stellar velocity dispersion at such a high redshift.

- Stellar velocity dispersion does not significantly evolve over the last 12 Gyr.
- But, we know that sizes and masses increase with time.
- This suggests that the mass growth does not occur equally at all radii; mass growth mostly occurs in the outer parts. That also drives the size evolution.
- This is consistent with the 2-phase formation scenario.
- But, this galaxy may be rotating!
- Step forward to a larger sample and also to JWST.

MOSFIRE spectrum



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