The VIMOS Ultra Deep Survey (VUDS): Lyα Emission and Stellar Populations of Star-Forming Galaxies at 2<z<6

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Why study Star-Forming Galaxies (SFGs) at z>2?

<u>For SFGs z~2-3</u>

Galaxies at the peak epoch of the global SFRD

Multi-wavelength studies and ground-based spectroscopy can be done at these redshifts

Lowest redshift at which we get ground-based spectra of LAEs

At these redshifts we can get statistical samples

<u>For SFGs z>3</u>

To better understand physical properties of high redshift galaxies

Lack of statistics -- Faint magnitudes, limited wavelength coverage and challenging spectroscopy makes it difficult to understand them in detail

Lyman-α Emission and Stellar Populations

Two techniques to select high redshift galaxies
photometric color selection and Narrow-band (NB) imaging

Stellar population studies of Lyα emitters (and their comparison with non-emitters) at z~>2 are based on 'UV-selection' or 'NB-selection' to identify Lyα emitters

e.g., Shapley+ 2001, 2003; Erb+2006,
Pentericci+ 2007, Verma+ 2007, Kai+ 2008, Reddy+ 2008, Kornei+ 2010,
Guaita+ 2011

Results vary based on the selection method, sample size and luminosities probed

Our goal is to use the 'UV-selection' approach on ~>5000 VUDS galaxies (~>L^*_{UV}) over a large redshift range (2<z<6) to investigate stellar populations of Lyα emitters

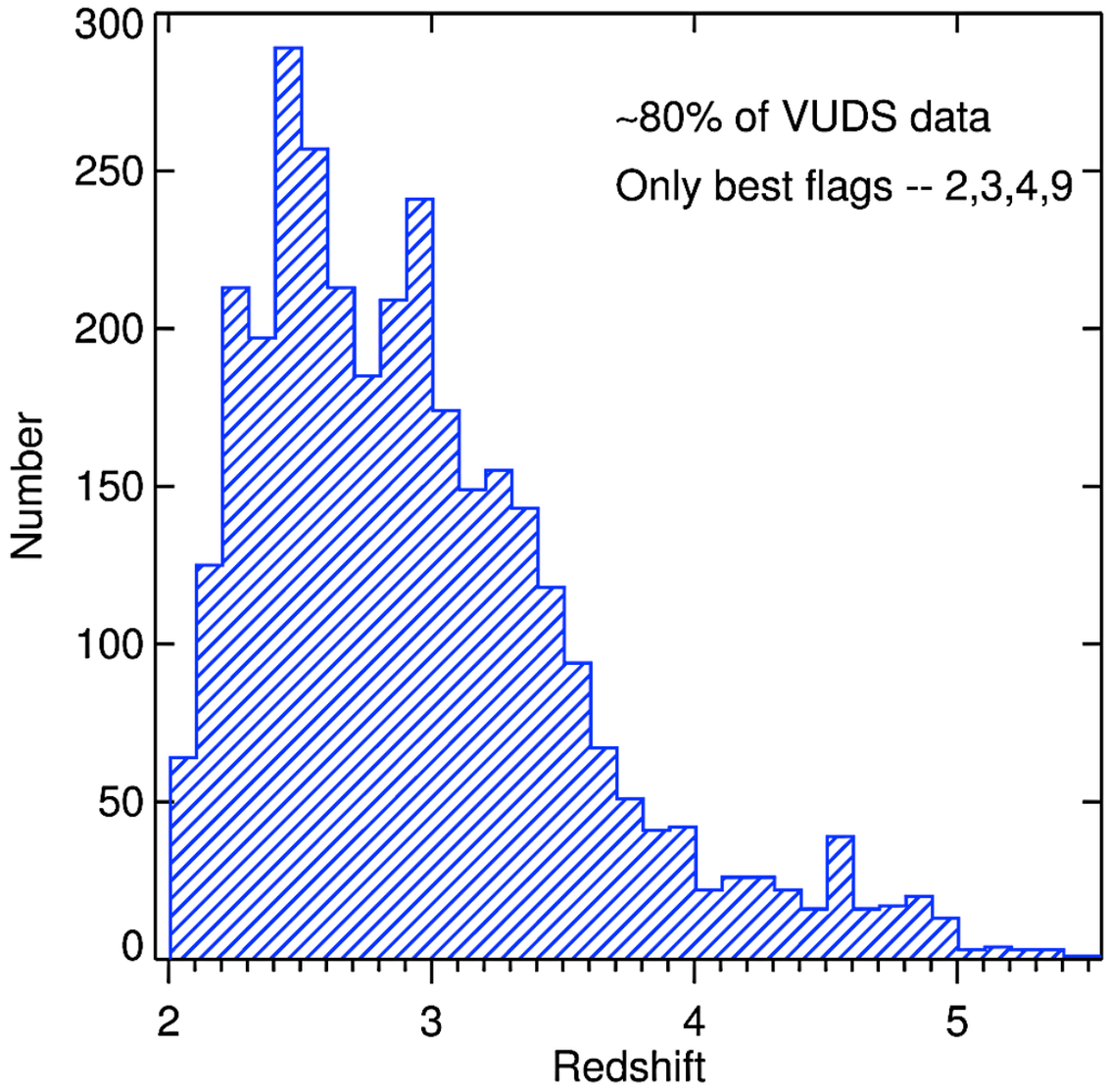
The VIMOS Ultra Deep Survey (VUDS)

[O. Le Fèvre+ 2015, A&A, in press (arXiv:1403.3938)]

- A large (1 deg^2, 3 fields, ~10,000 galaxies) and deep (640 hours, 14h per exposure) VIMOS spectroscopic survey

- ECDFS, VVDS-02h, COSMOS fields with extensive multi-wavelength data

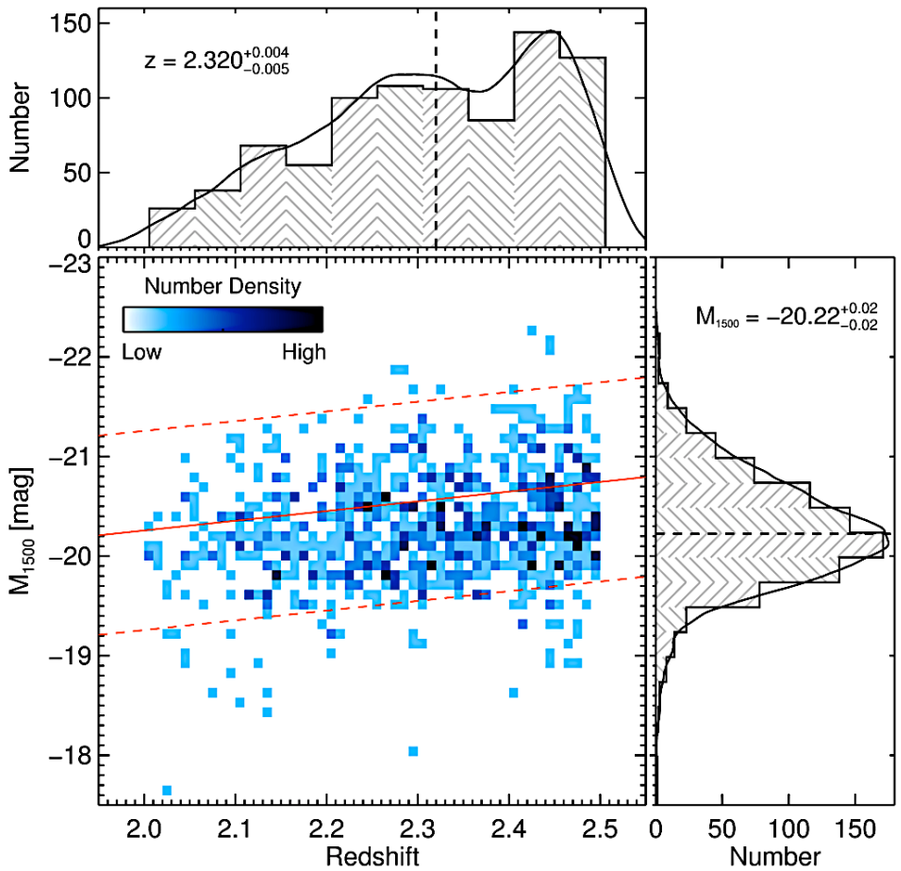
- VUDS covers full wavelength range from ~3600Å to 9500Å (Lyα line visible at 2<z<6)

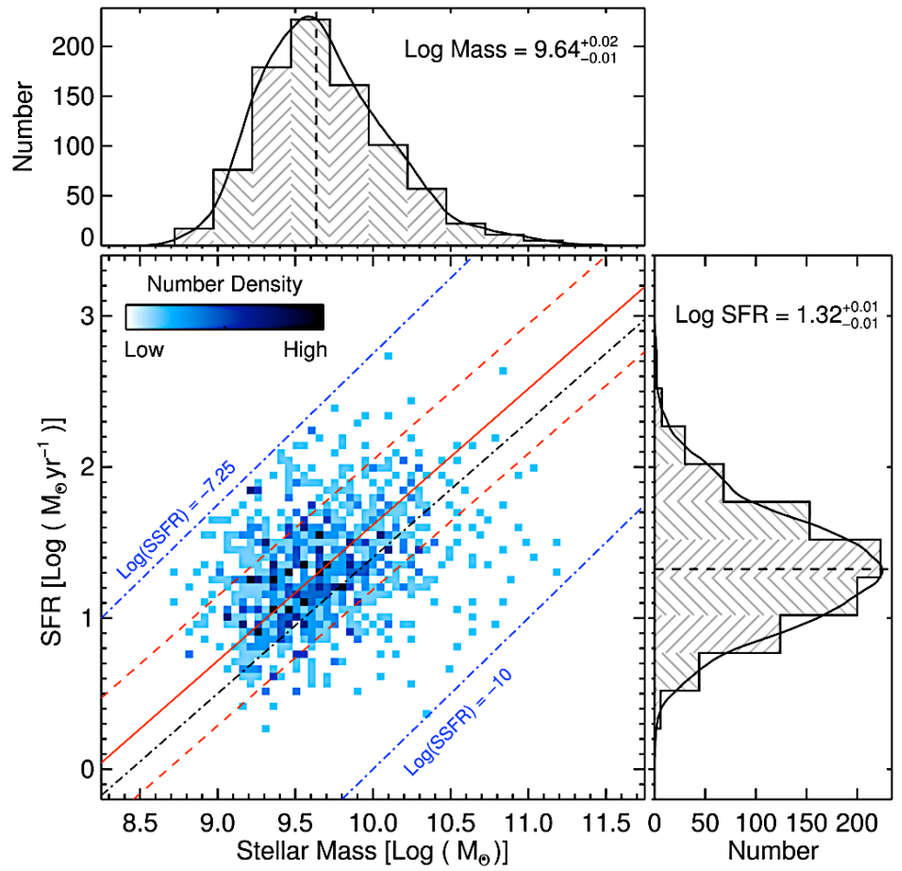


- Target selection based on photometric redshifts+color selection (i_{AB}<~25 mag)

Star-Forming Galaxies at 2<z<2.5

[N. Hathi+ 2015, A&A, submitted (arXiv:1503.01753)]

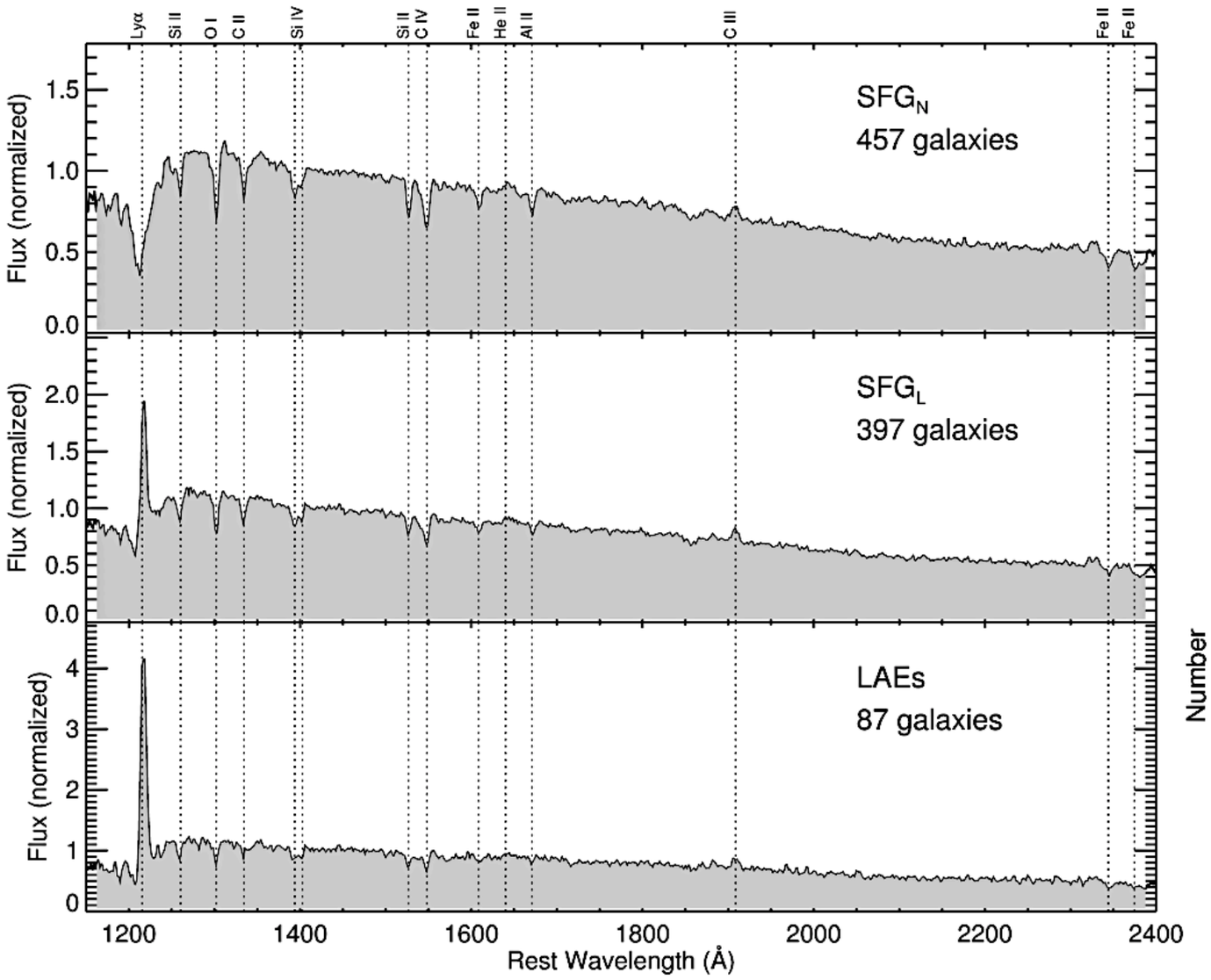




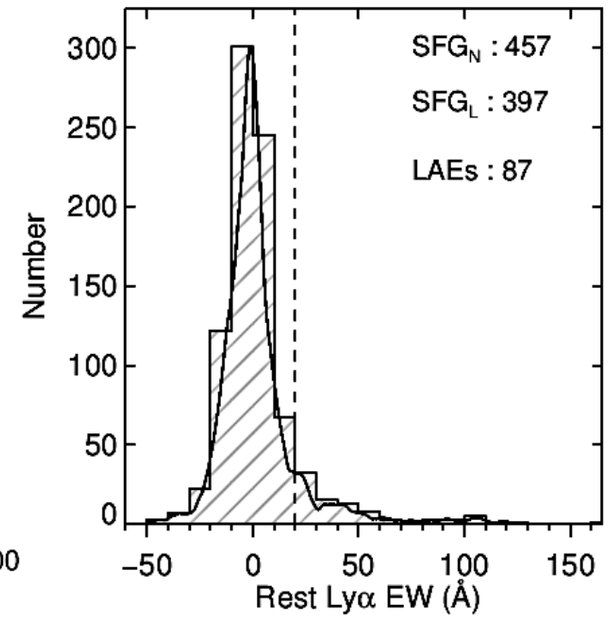
SFGs at 2<z<2.5

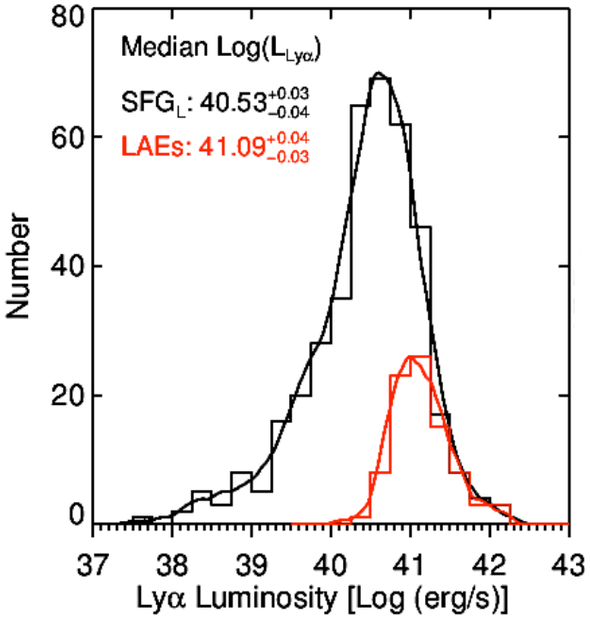
- have UV luminosities around L^* ($M^*\pm1$ mag),
- spans a large range in SFR (~3 to 150 $M_\odot$/yr) and stellar mass (~5×10^8 to 10^{11} $M_\odot$)
- are 'normal' SFGs on the star-forming MS but we see a large scatter (for details see Tasca+ 2015, Cassarà+ 2015)

Star-Forming Galaxies at 2<z<2.5



We divide SFGs in 3 groups: SFG$_N$ (EW≤0Å), SFG$_L$ (EW>0Å), and LAEs (EW≥20Å)

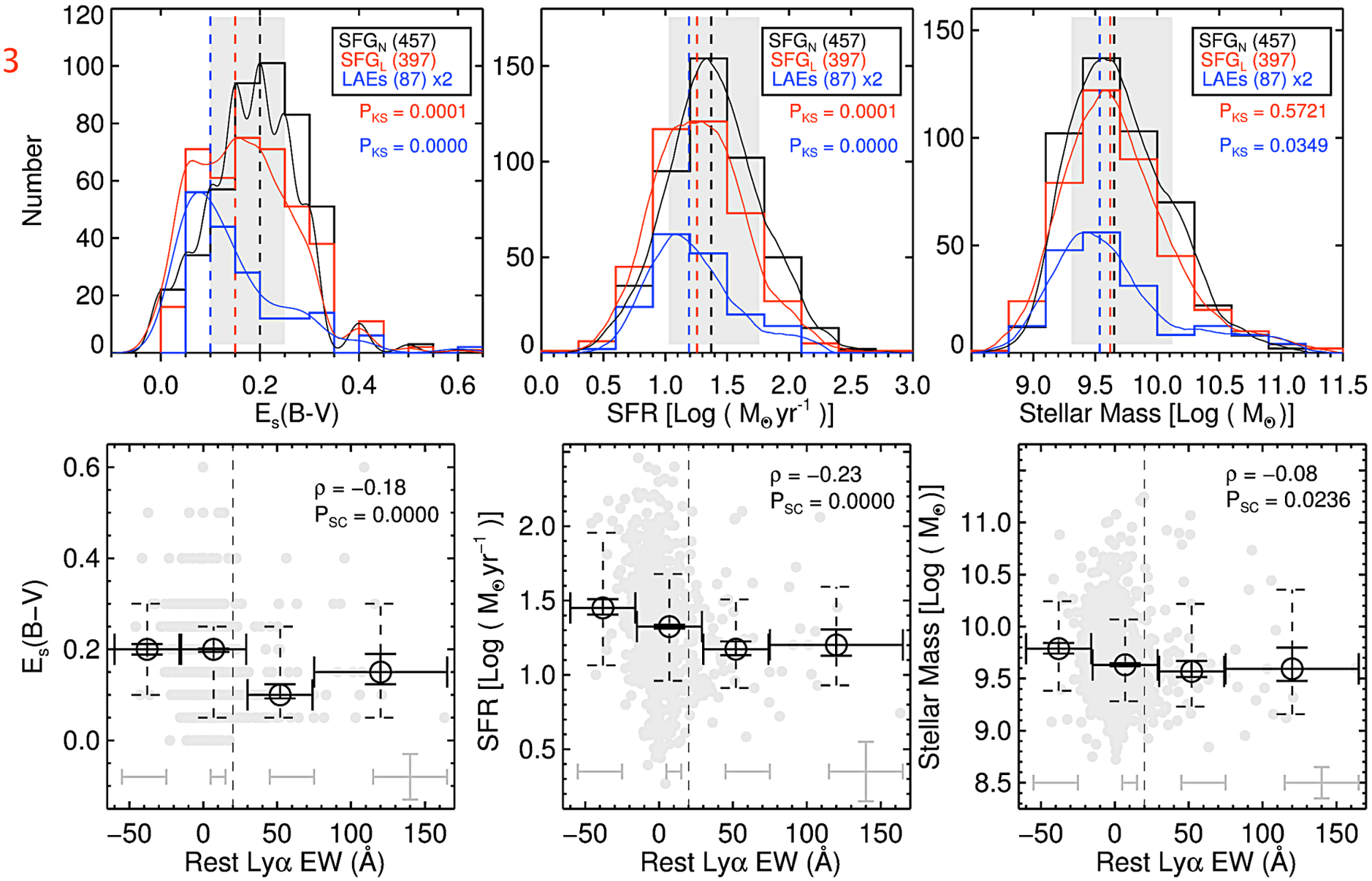




- Rest Lyα EW range from strong absorbers (-50Å) to strong emitters (~100Å) -- fraction of LAEs is ~10%
- Median Lyα luminosity is ~10^{41} erg/s for LAEs (~an order of magnitude lower than NB LAEs)

Lyα Emission & Stellar Populations at 2<z<2.5

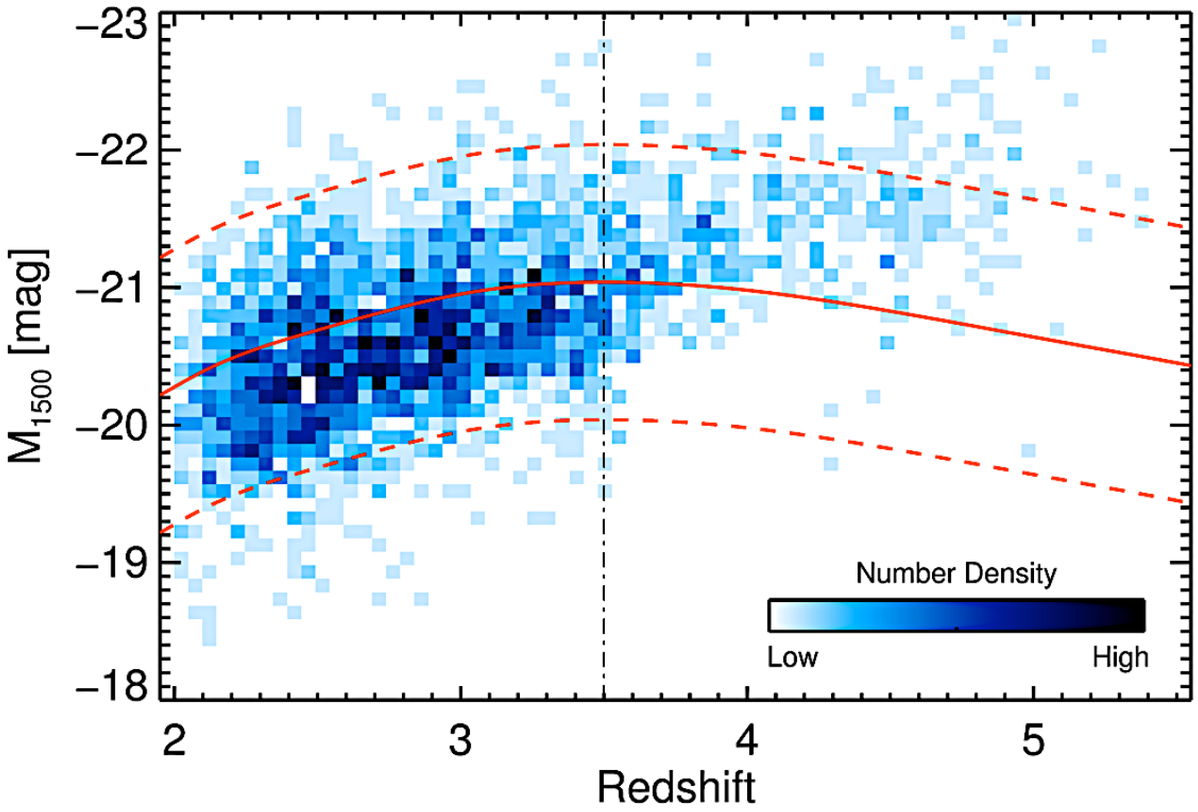
Hathi+ 2015
arXiv:1503.01753

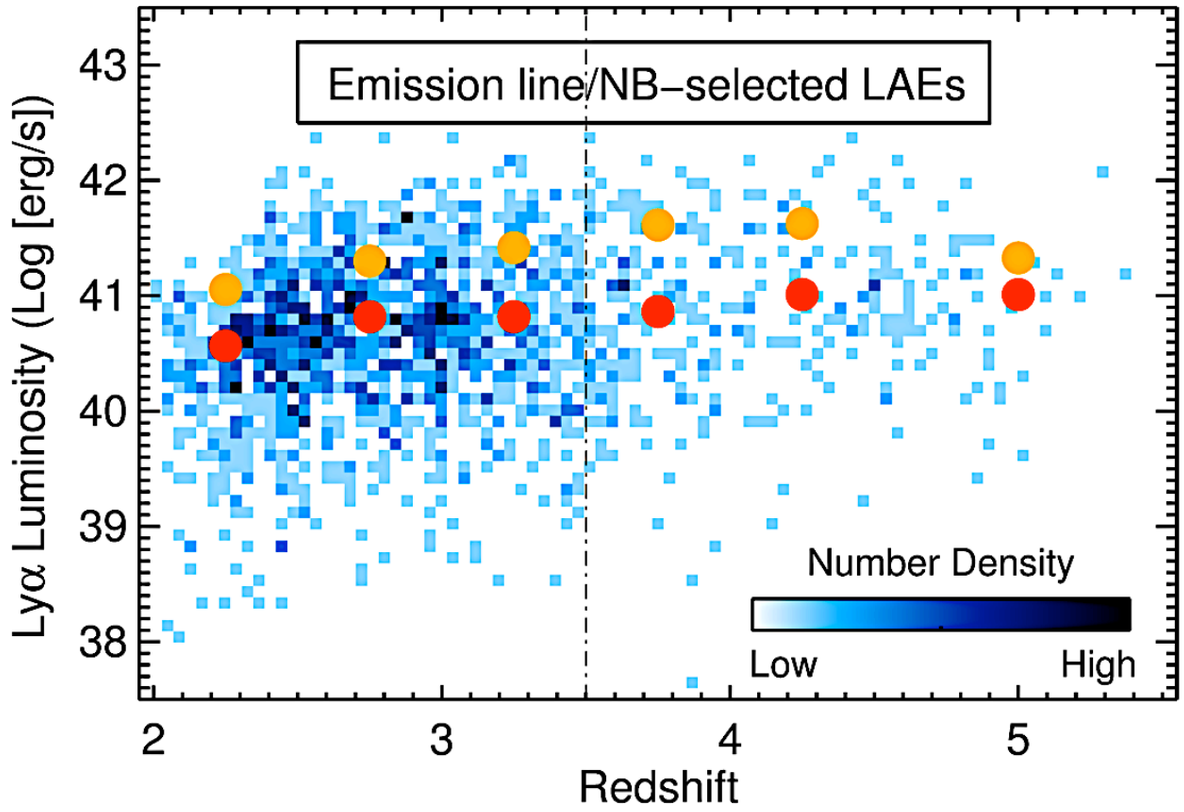


- Galaxies with Lyα emission are on average less dusty, and less star-forming compared to non-emitters.
- Dust trend is also consistent with the UV spectral slope values.
- No significant difference in stellar mass.

Star-Forming Galaxies at 2.5≤z≤5.5

[Hathi+ 2015, in prep ** Work in Progress **]





- VUDS probes M^* ± 1 mag for SFGs at $2<z\leq3.5$, while SFGs at $z>3.5$ are mostly brighter than M^*
- VUDS probes Lyα luminosity fainter than typical strong Lyα emitters selected based on the NB imaging method

Lyα Fraction vs Redshift

[P. Cassata+ 2015, A&A, 573, A24]

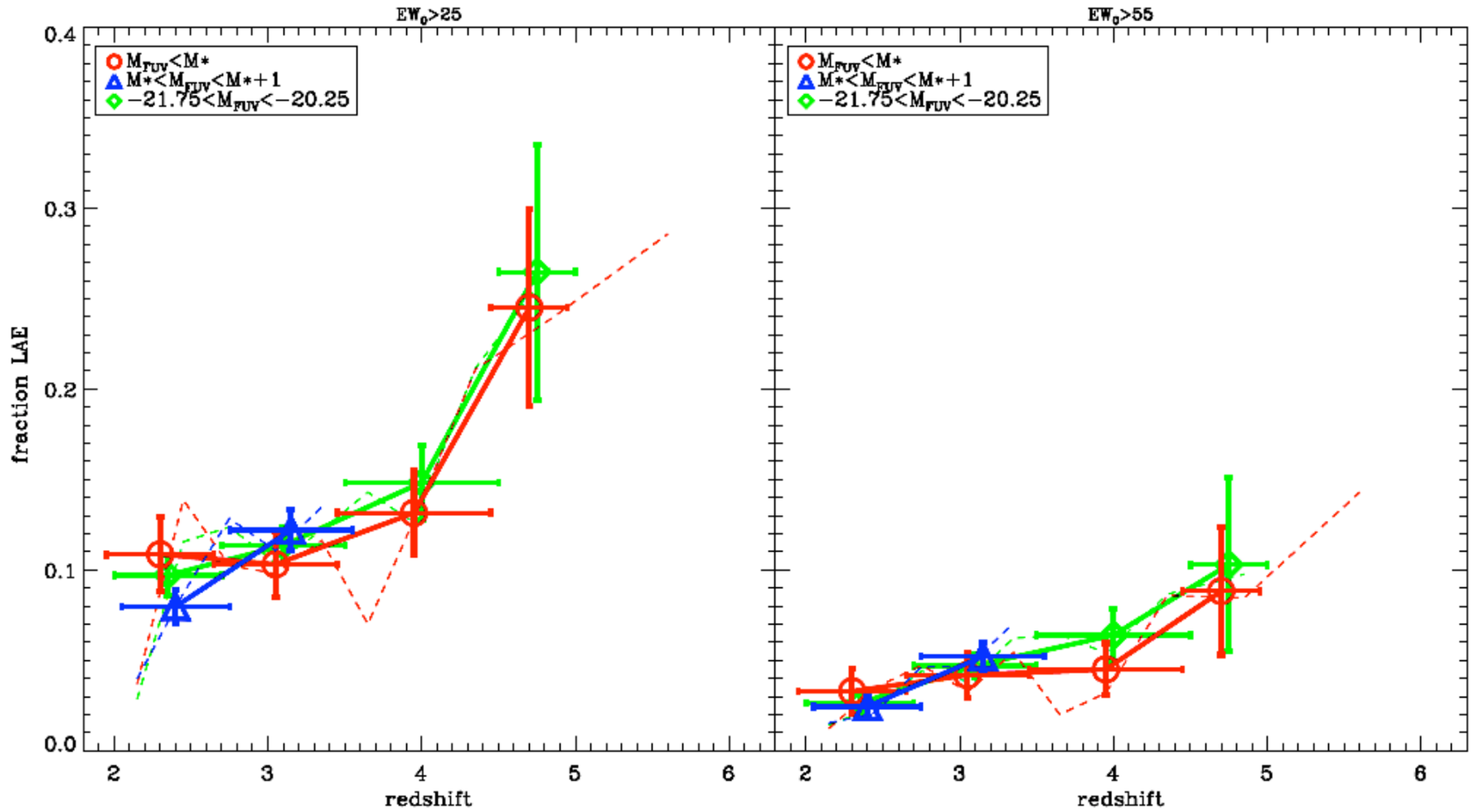


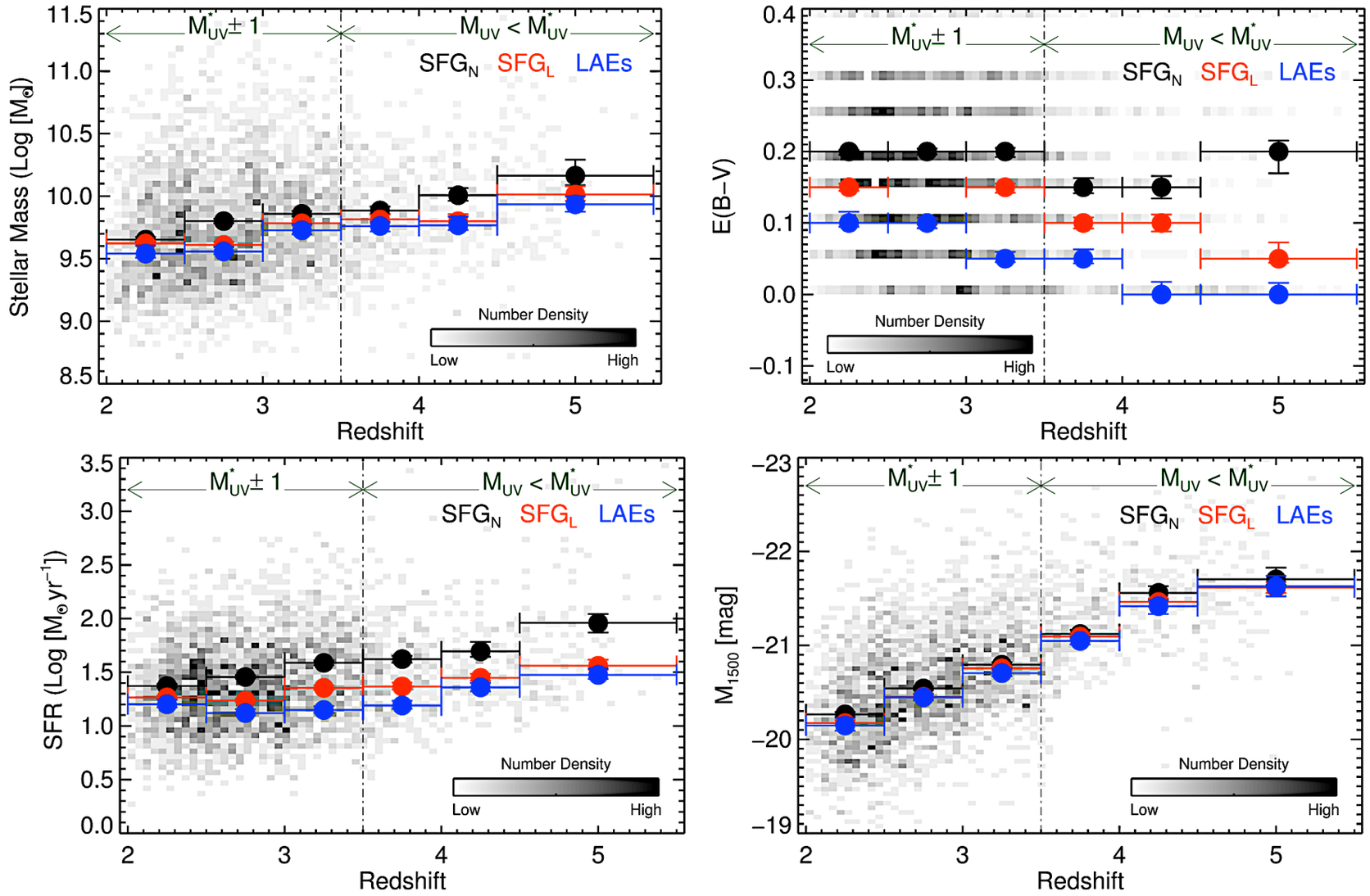
Fig. 3. *Left panel:* Our best estimate of the fraction of galaxies with EW$_0$(Lyα)> 25 Å, as a function of the redshift, for three intervals of far-UV absolute magnitudes: faint objects ($M^* < M_{FUV} < M^* + 1$) are shown in blue; bright objects ($M_{FUV} < M^*$) are shown in red; objects with $-21.75 < M_{FUV} < -20.25$ are shown in green. The fiducial values, shown by the continuous thick lines, include all the galaxies with spectroscopic flag 2, 3, 4 and 9, and also all the galaxies with a spectroscopic flag 1 and a spectroscopic redshift that differs less than 10% from the photometric one. The dashed lighter lines show a finer binning in redshift. *Right panel:* same as left panel, but for galaxies with EW$_0$(Lyα)> 55 Å

Lyα fraction at 2<z<6 from VUDS shows increasing Lyα fraction with the redshift

This result is consistent with Stark et al. and other studies

Star-Forming Galaxies at 2.5≤z≤5.5

[Hathi+ 2015, in prep ** Work in Progress **]



- At higher redshifts (z≥2.5), galaxies with Lyα emission are -- on average -- less dusty and less star-forming
- Though at higher redshifts most galaxies are brighter than M^*, these results are similar to galaxies at 2<z<2.5

Summary

For VUDS Lyα emitters and non-emitters at 2<z<6 selected based on their UV magnitudes and covering ~>L^*_{UV} luminosities, we find that

- On average, Lyα emitters are less dusty and less star-forming compared to non-emitters. We do not find any significant difference in stellar mass

- At z~2, these results are broadly consistent with UV-selected studies at z~2-3

- At z~2, we find a larger fraction of IRAC detected ($m_{3.6}$<~25 AB mag) LAEs compared to NB-selected LAEs at similar redshifts ==> UV-selected LAEs are more evolved/more massive compared NB-selected LAEs

LAEs are diverse populations and their correlations depend on various things (e.g., sample selection, range of luminosities/stellar masses)

Thank You!