# A Population of Extreme [OIII]+Hβ Emission Line Galaxies Tracing an Overdensity at $z$~3.5 in CDF-South

Ben Forrest
Texas A&M University
Advisor: Kim-Vy Tran
19 September, 2017

# Many-color selection of EELGs through Composite SED Construction from the ZFOURGE Catalogs

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(Last Talk before Coffee)

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MITCHELL INSTITUTE
TEXAS A&M UNIVERSITY

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Fourstar Galaxy Evolution Survey

# Outline

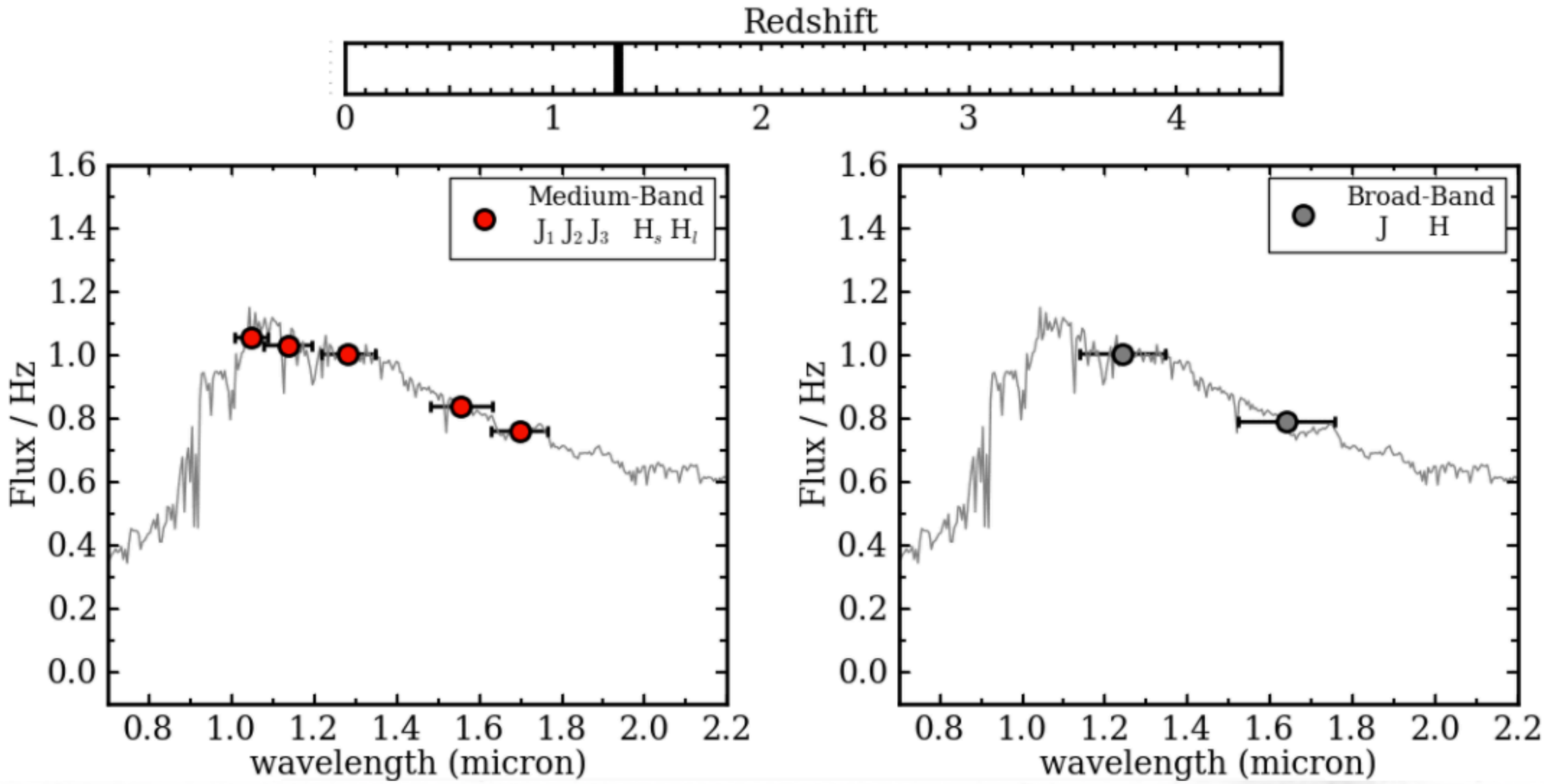
0. ZFOURGE

1. Construction of Composite SEDs

2. Classification

3. Properties

# ZFOURGE

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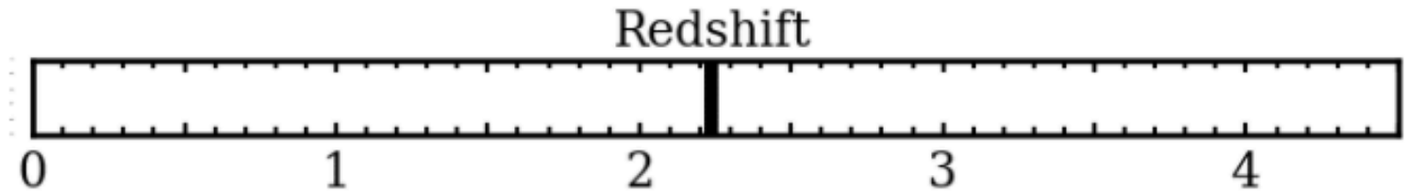
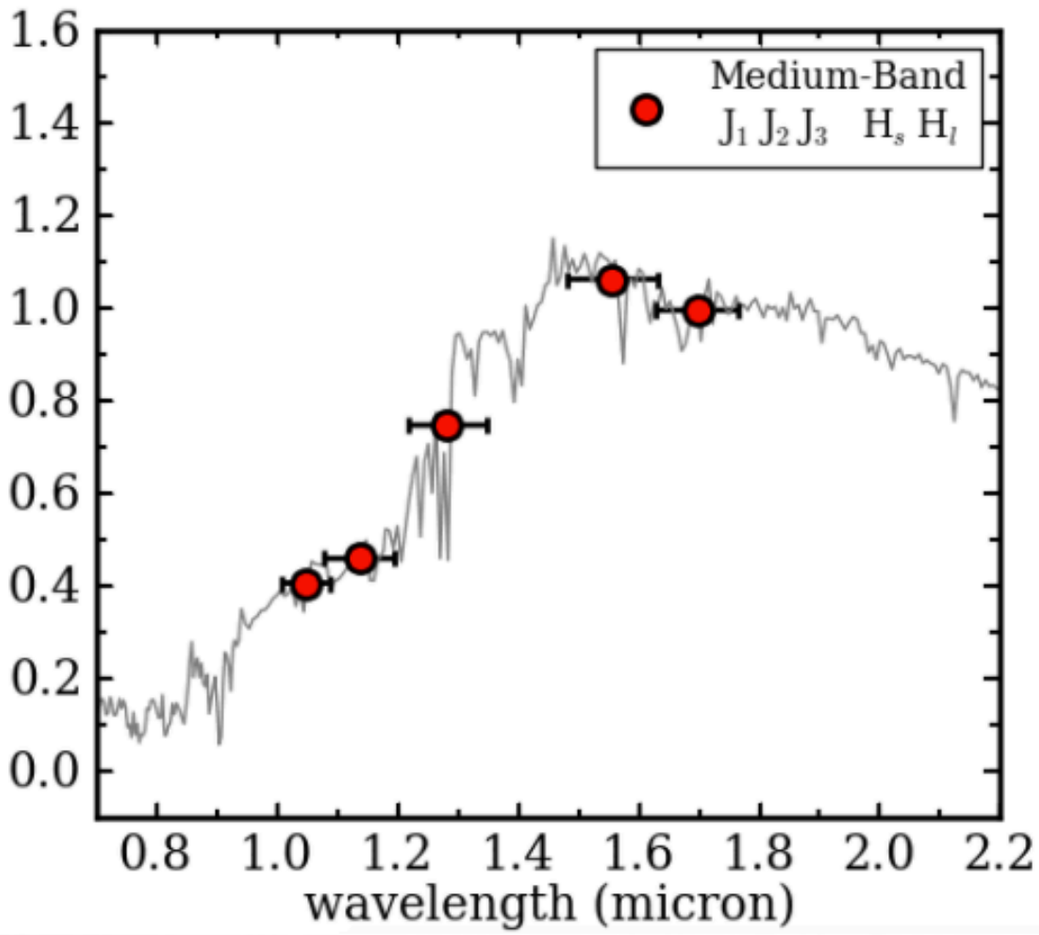
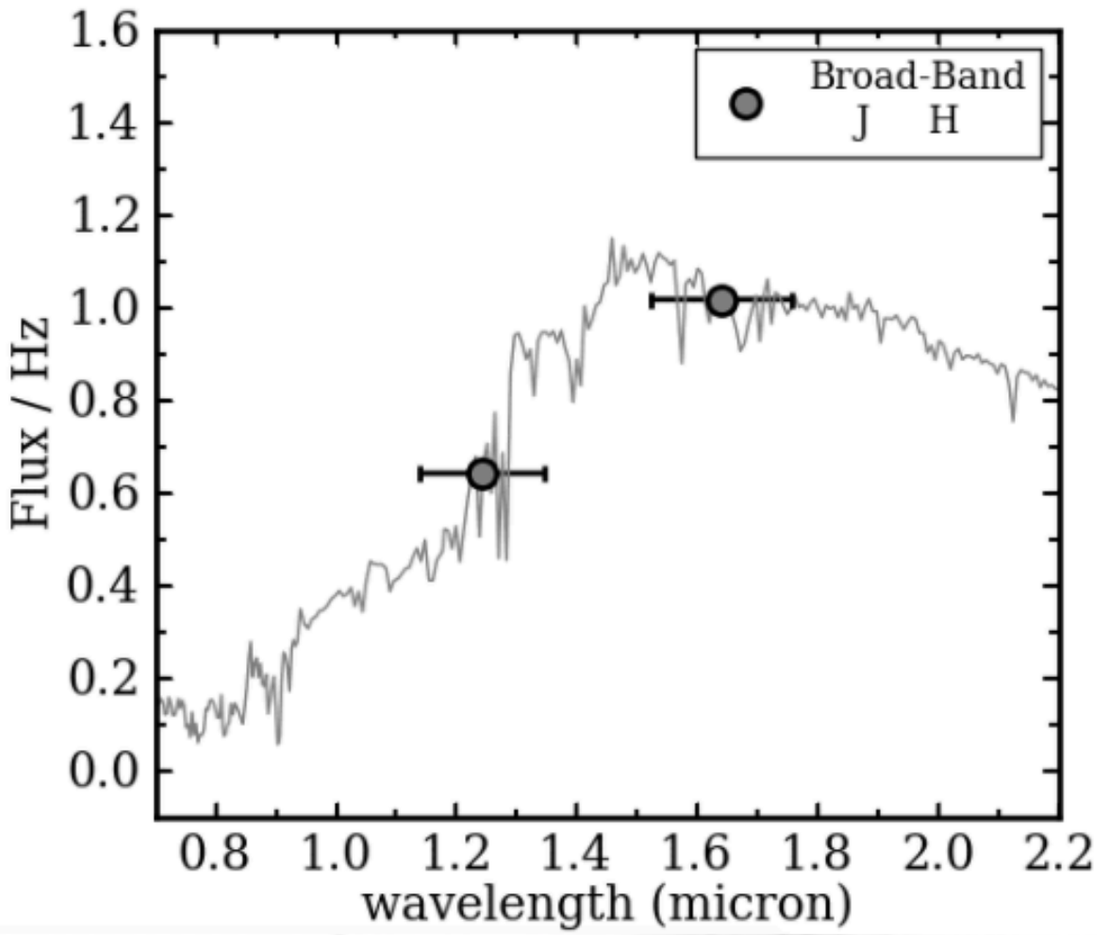
# ZFOURGE

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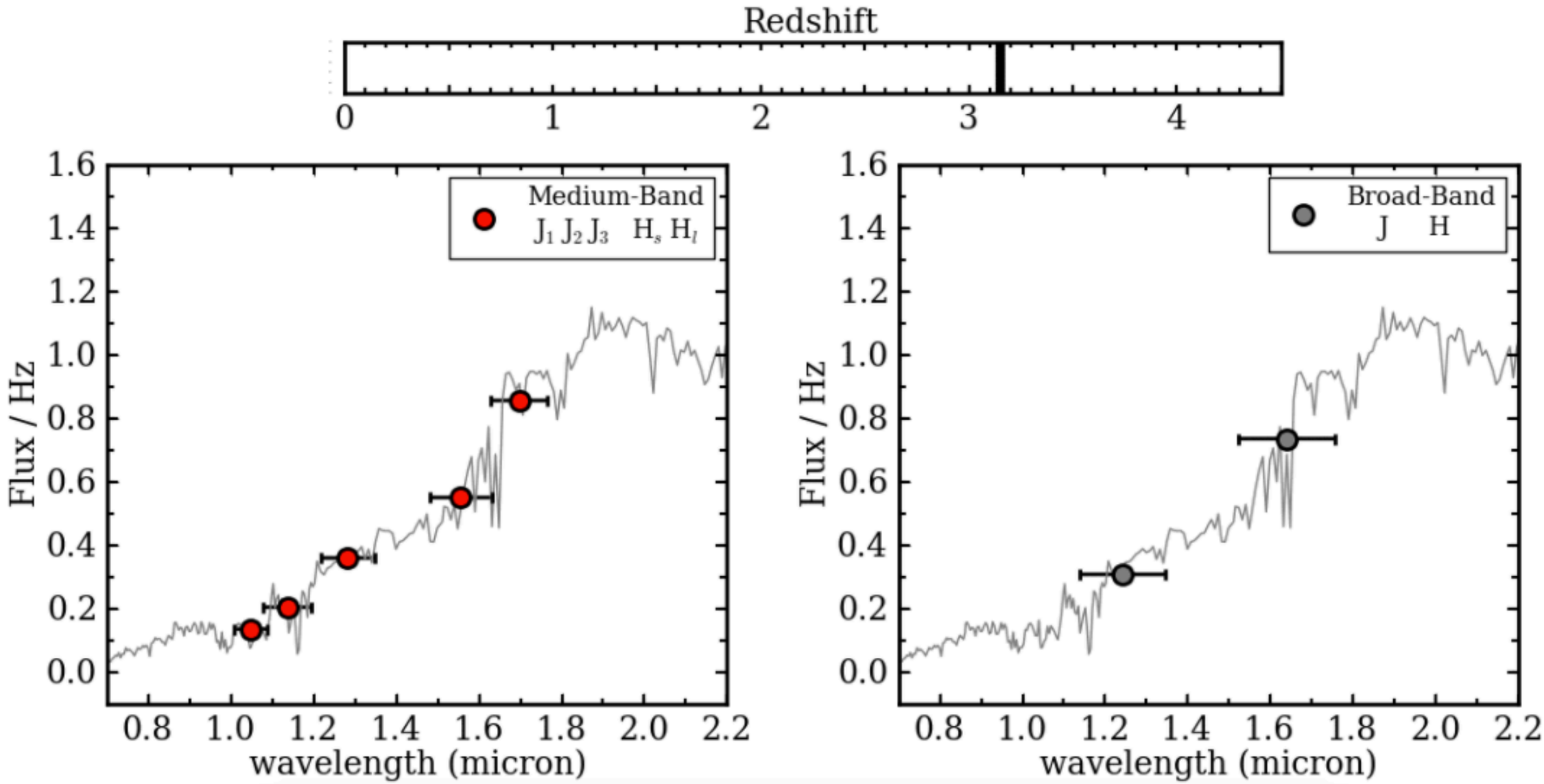
# ZFOURGE

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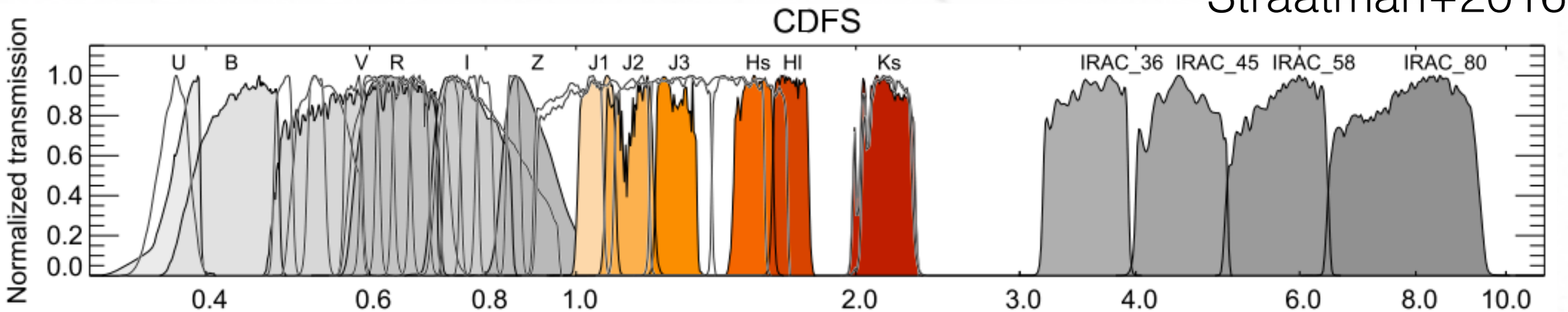
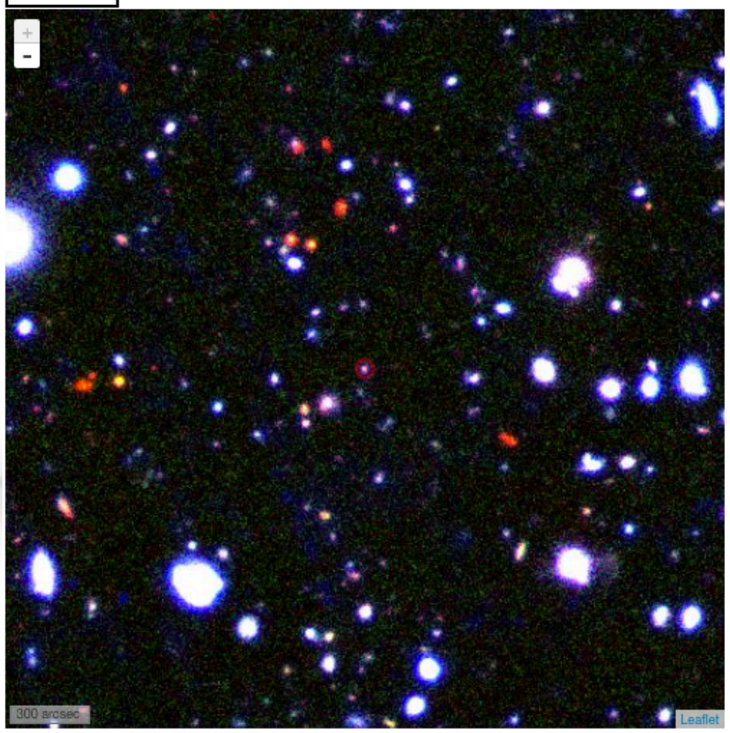
# ZFOURGE

Straatman+2016




40 photometric measurements

CDFS COSMOS UDS




Filters for color image: deep Ks-band, combined J1, J2, and J3, and F814W.

**Cursor Position:**
x, y: 3784, 7371
RA, DEC: 53.11428, -27.66798

**Selected Object:**
Object: 14888

x, y: 4262.1, 4011.0
RA, DEC: 53.0914917, -27.8080635
$mag_K$: 24.55
$Z_{phot}$: 2.35
$Z_{spec}$: No
Star Flag: 0
Use Flag: 1

**Jump to Coordinates:**
RA (52.962787 to 53.292525):

DEC (-27.975088 to -27.625102):

Zoom Level (0 to 4):

Go To

**Jump to Object:**
Object Number (1 to 30911):
14888

Zoom Level (0 to 4):
4

Go To

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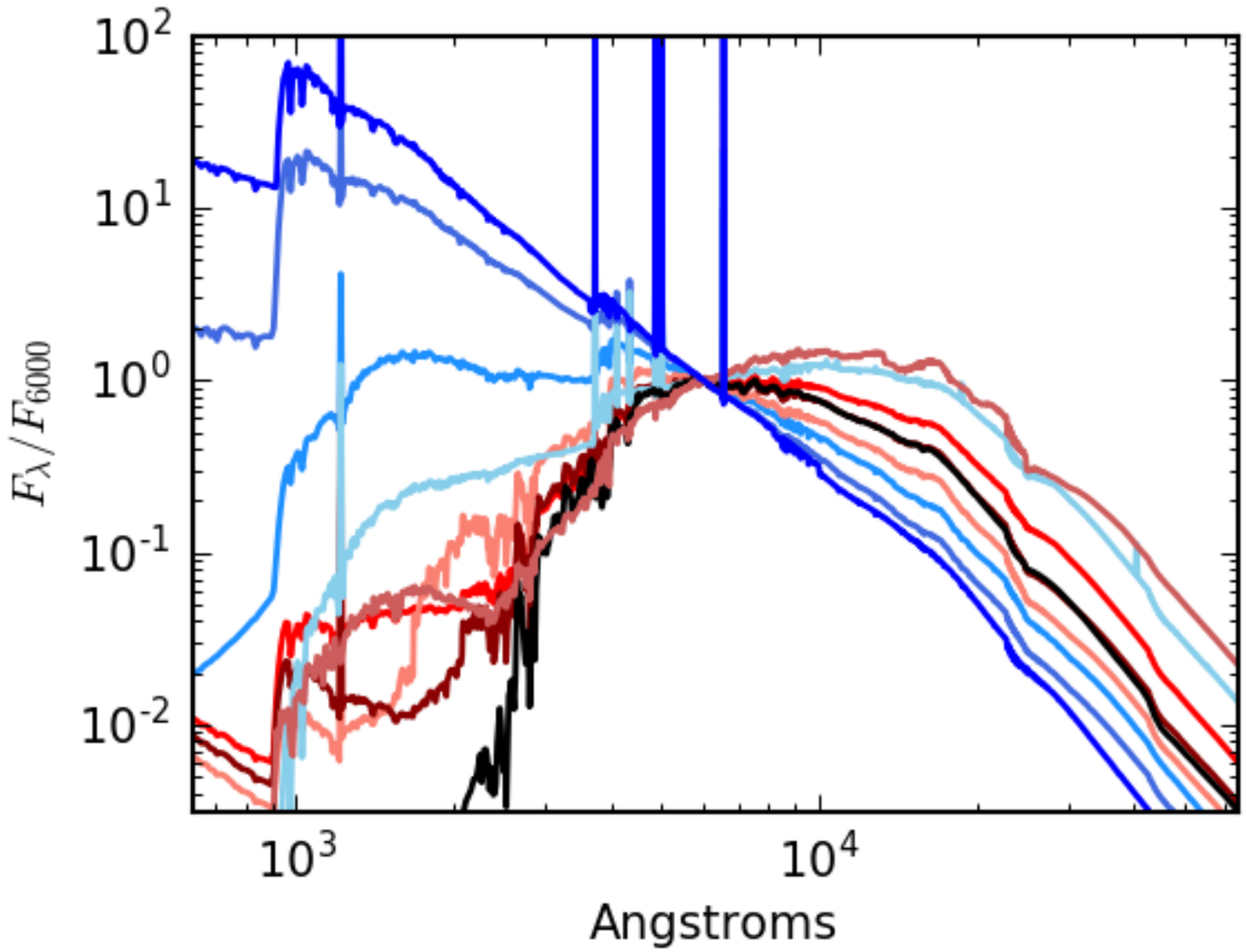
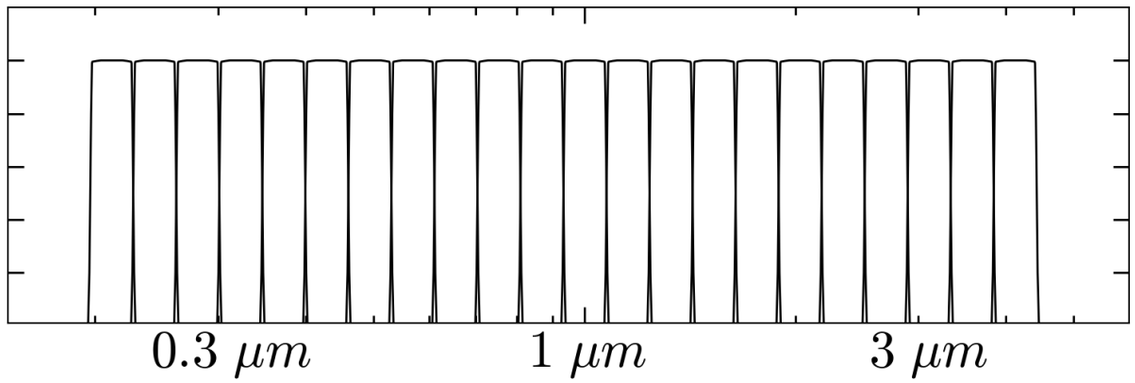
# EAZY Templates




Brammer+2008; Fioc & Rocca-Volmerange, 1999; Erb+2010; Whitaker+2011; Straatman+2016

# Composite SEDs - Grouping Galaxy SEDs



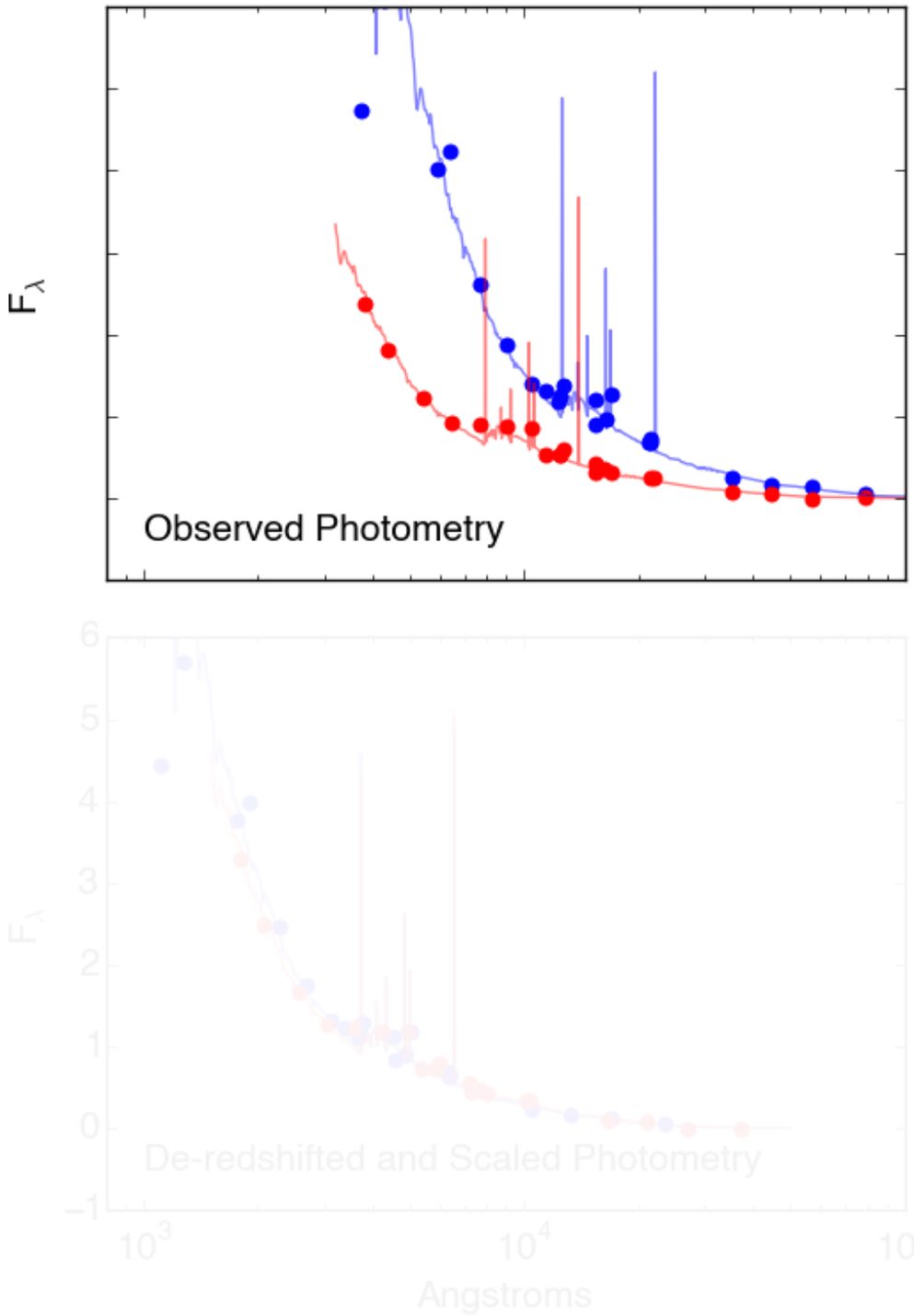

$$b_{12} = \sqrt{\frac{\Sigma(f_\lambda^{ob1} - a_{12} f_\lambda^{ob2})^2}{\Sigma(f_\lambda^{ob1})^2}}$$

Method pioneered in Kriek+2011

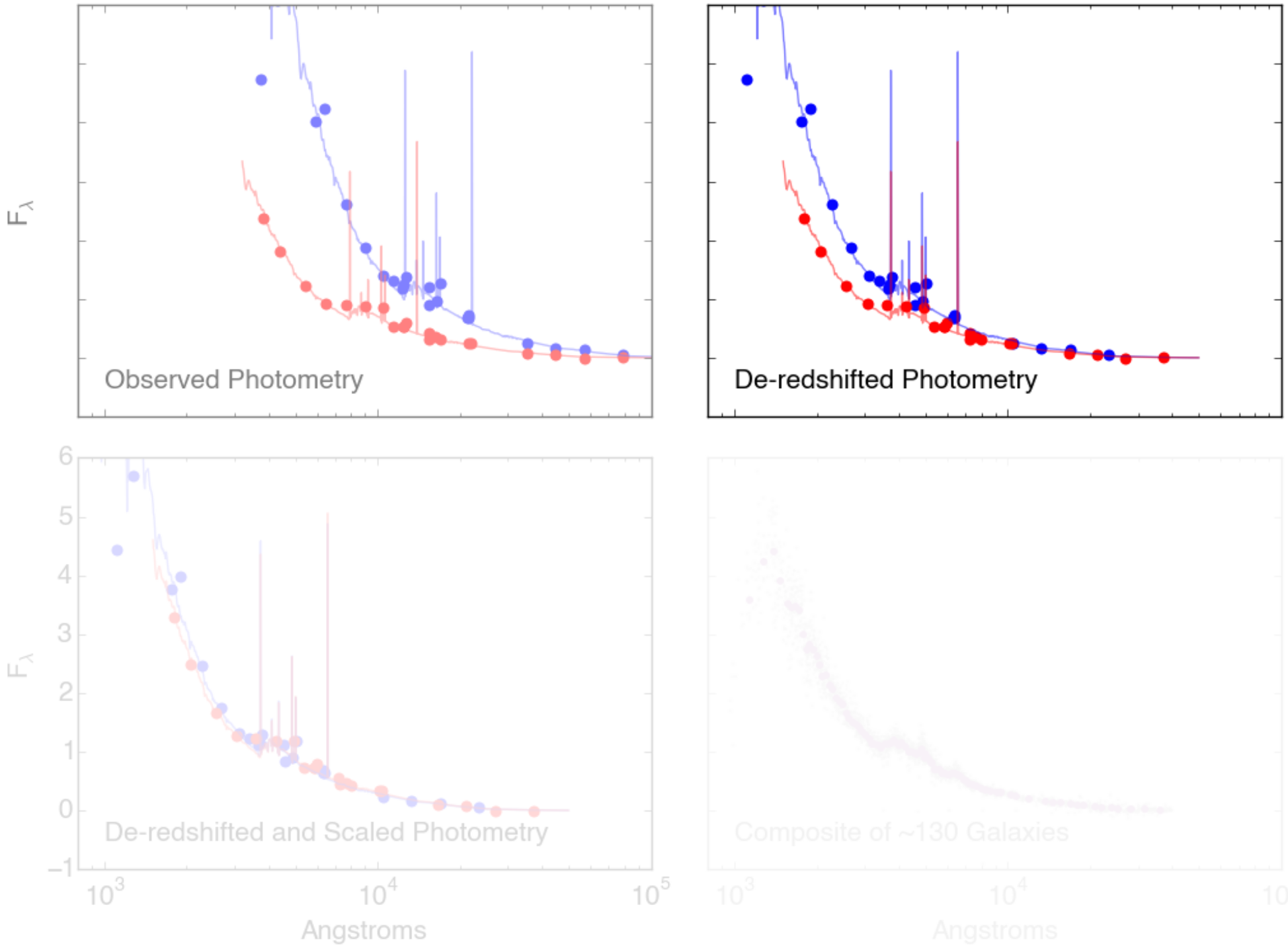
$$a_{12} = \frac{\Sigma f_\lambda^{ob1} f_\lambda^{ob2}}{\Sigma(f_\lambda^{ob2})^2}$$

- Compare the synthetic rest-frame photometry in 22 bands.
- The smaller the value of *b*, the more similar the photometry of the two SEDs.
- Only synthetic photometry between two observed bands is used.

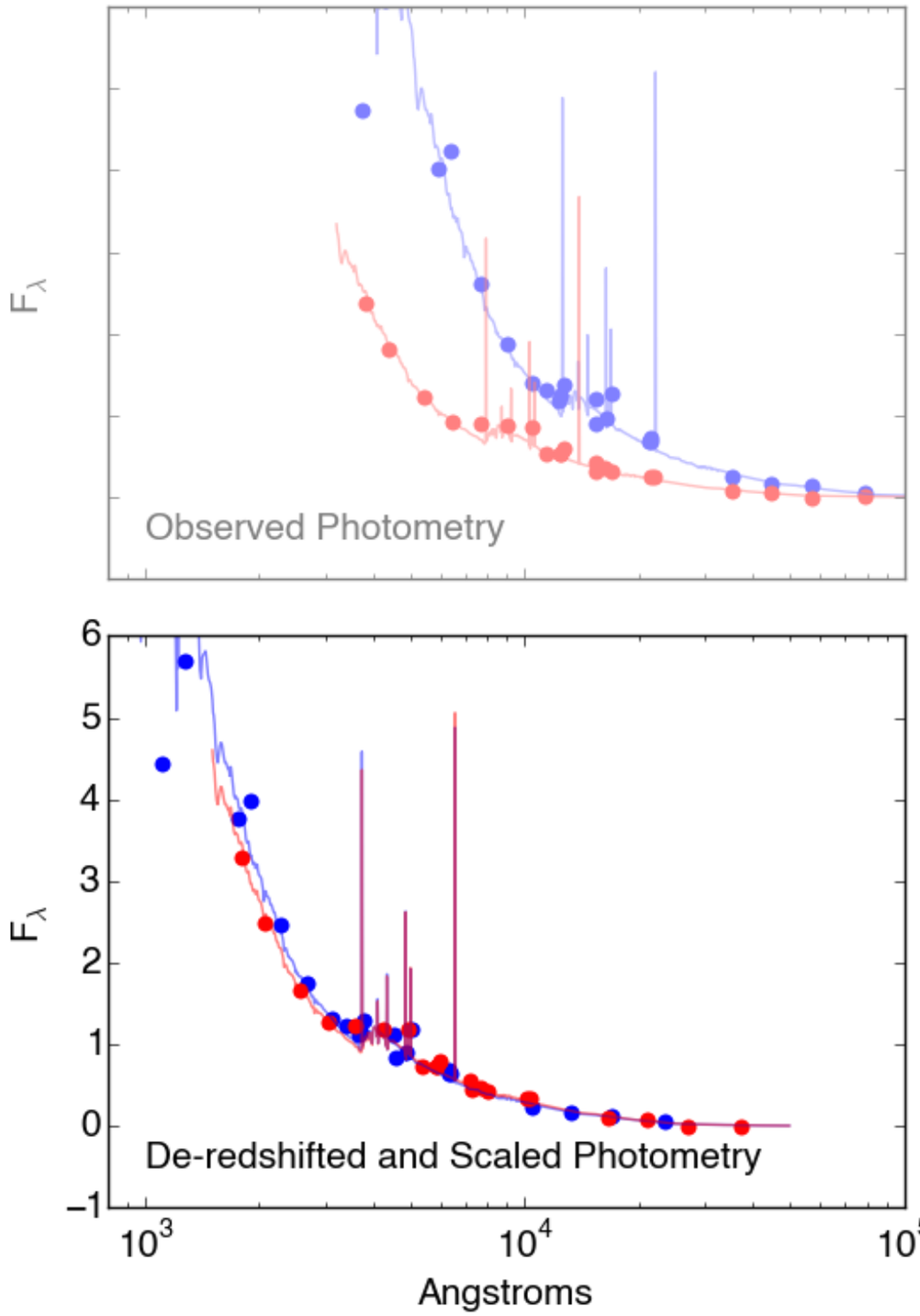
# Building Composite SEDs



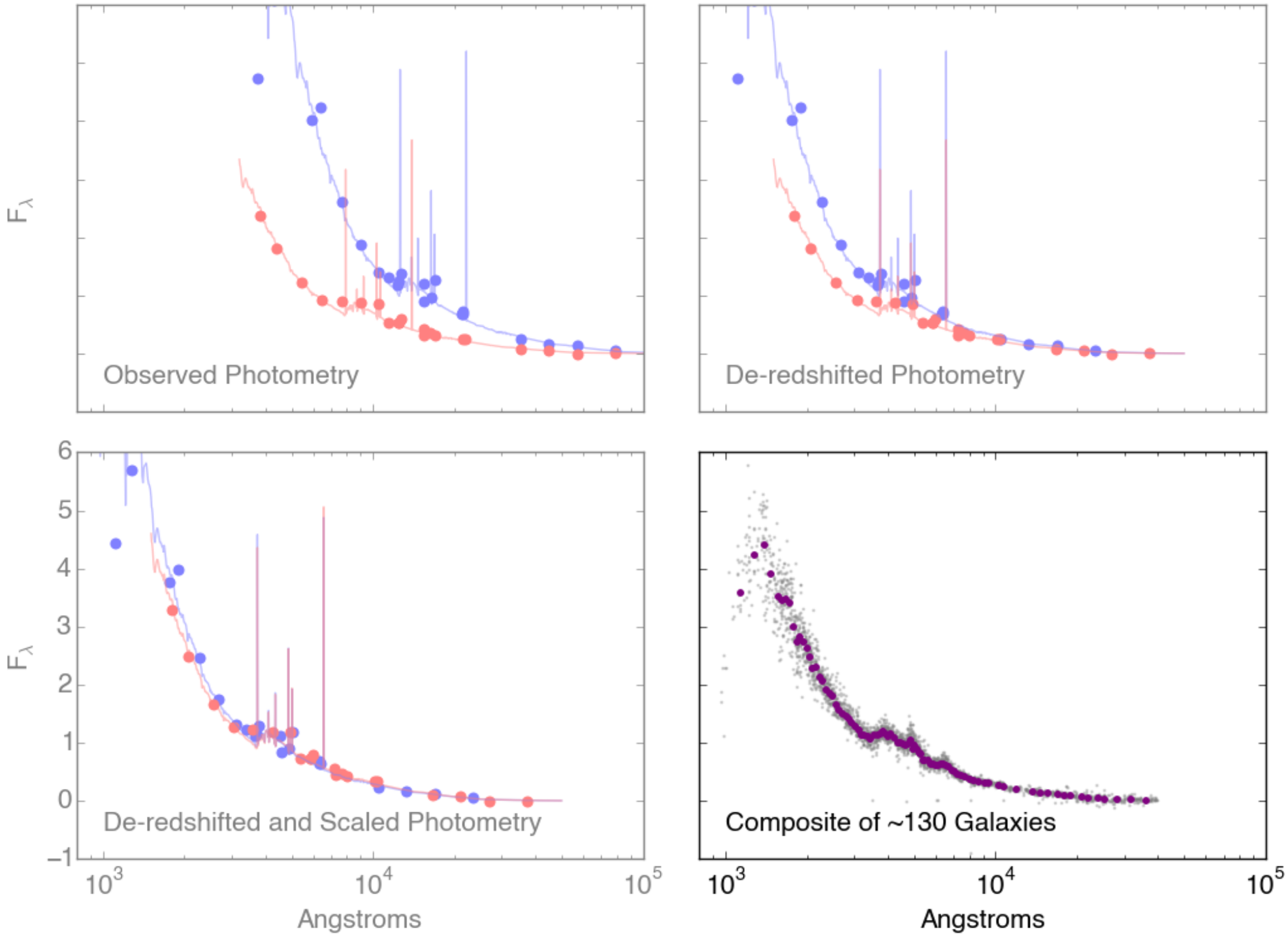
# Building Composite SEDs



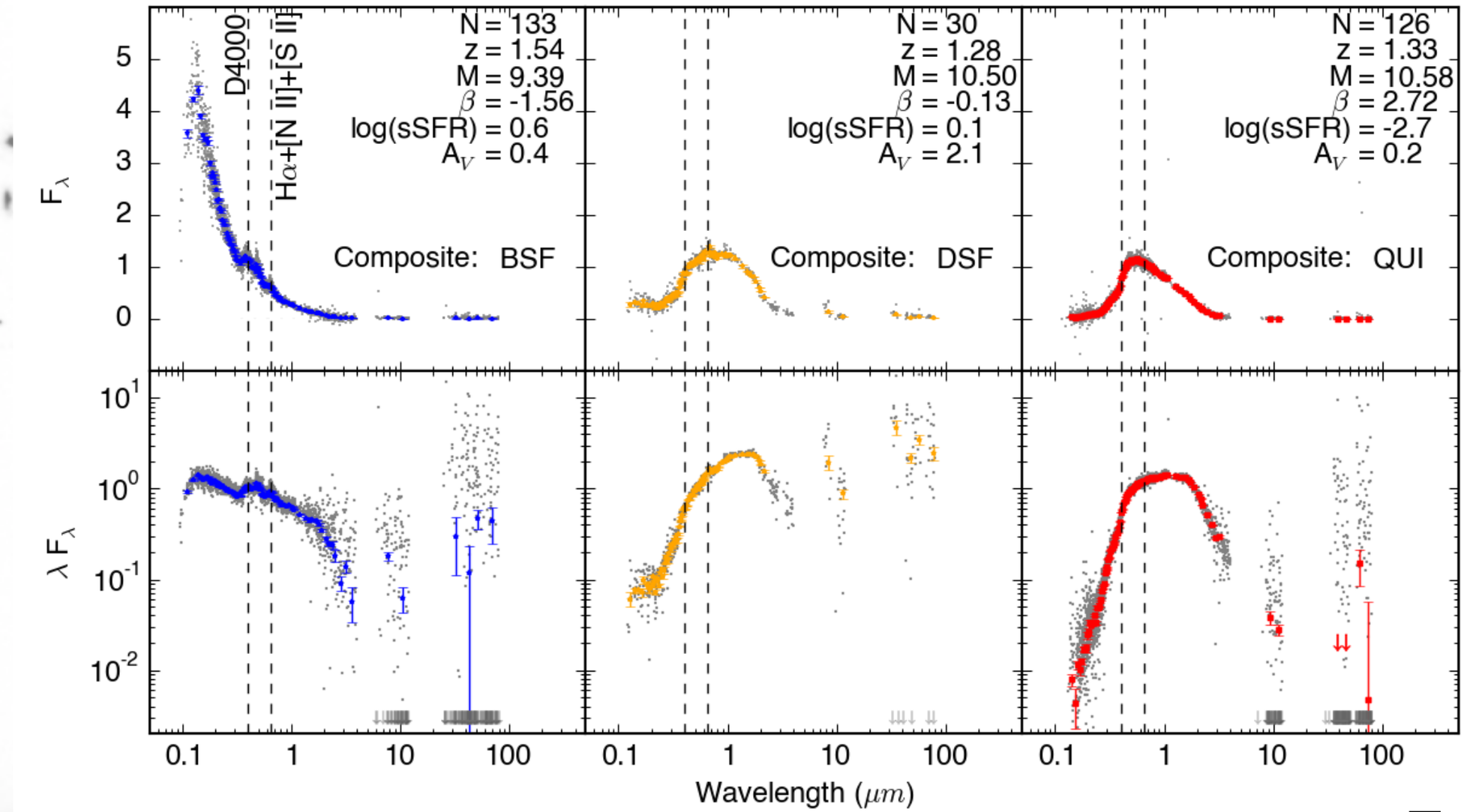
# Building Composite SEDs



# Building Composite SEDs

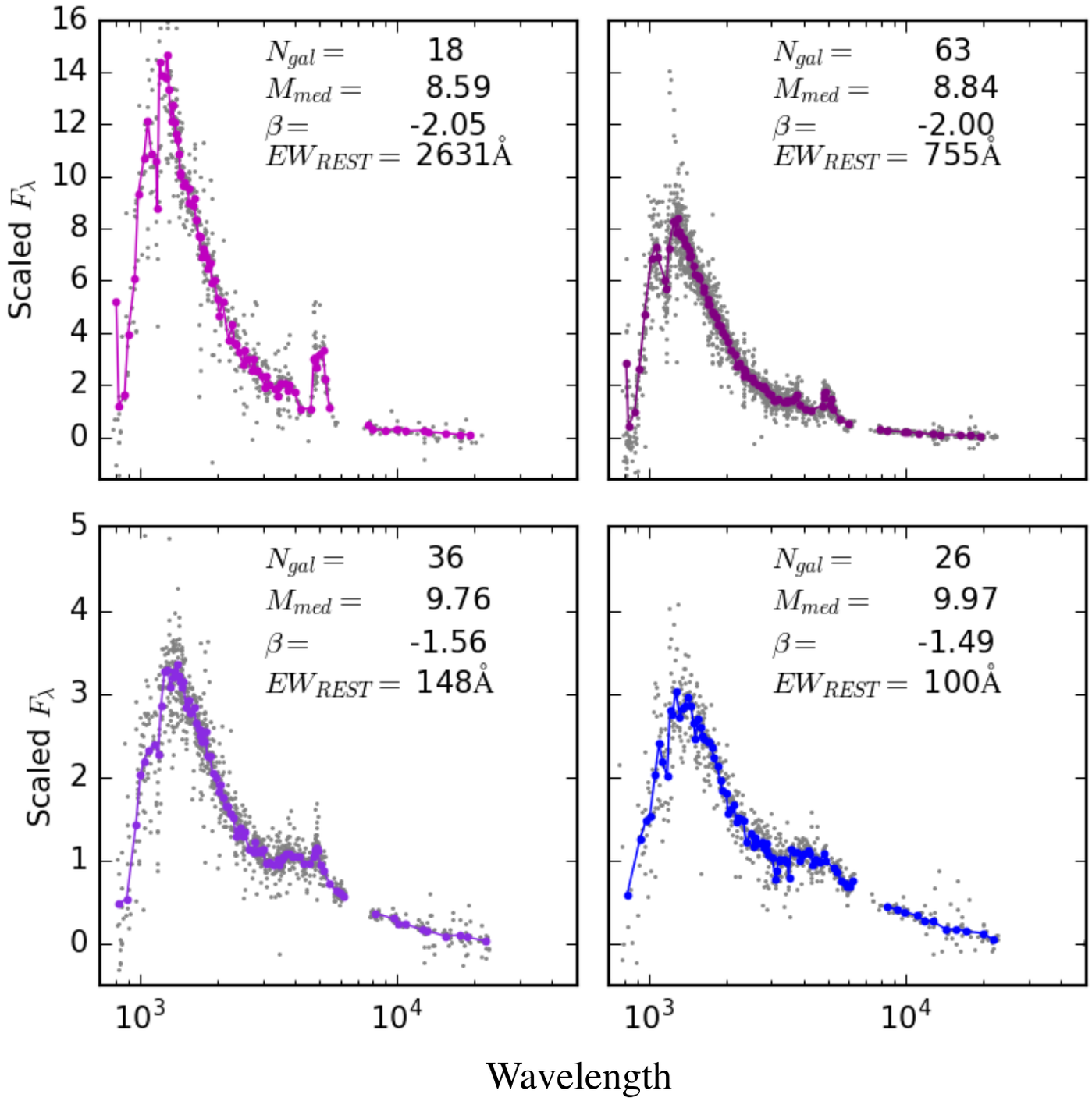


# Example Composite SEDs

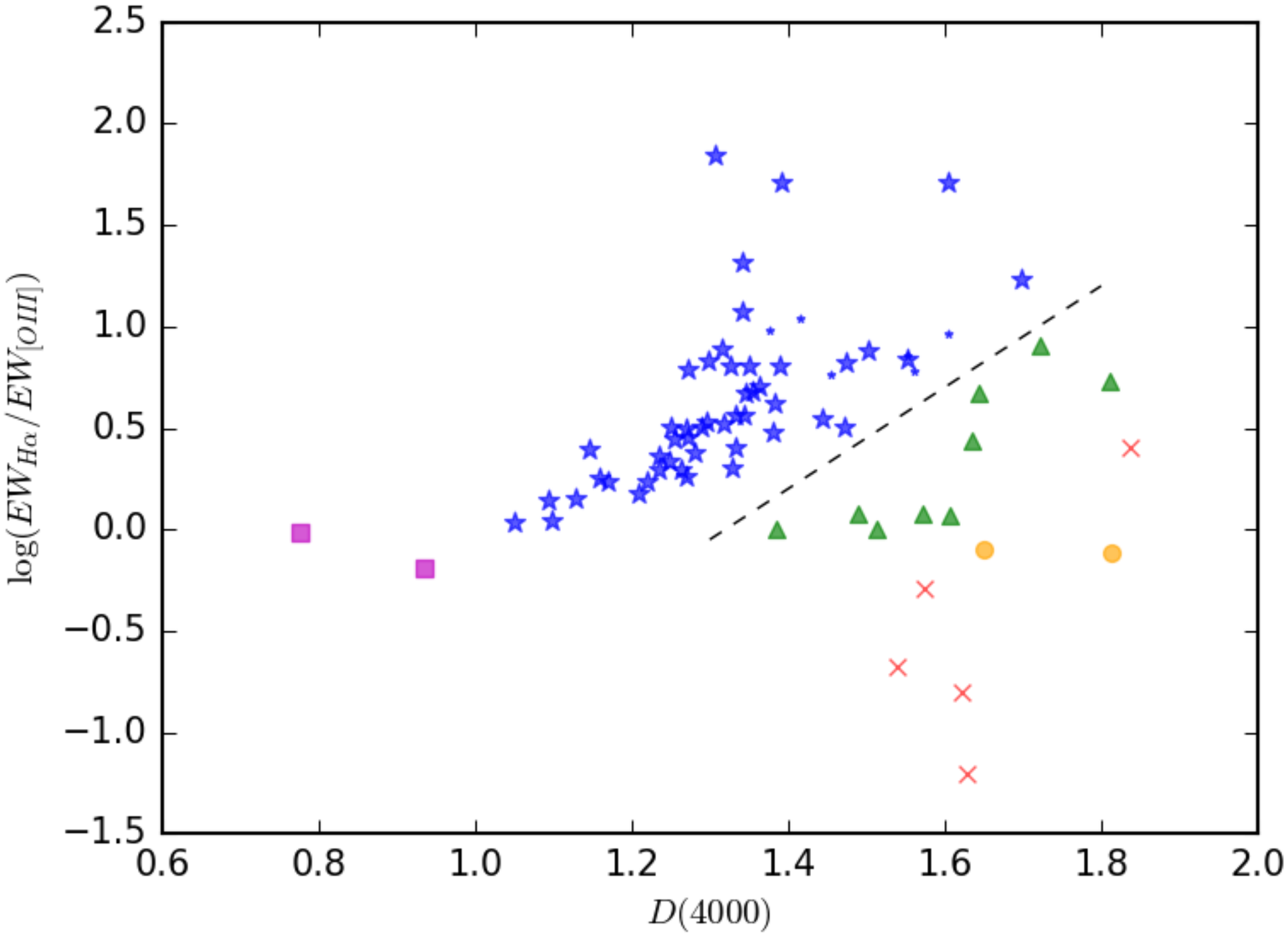



Forrest+16

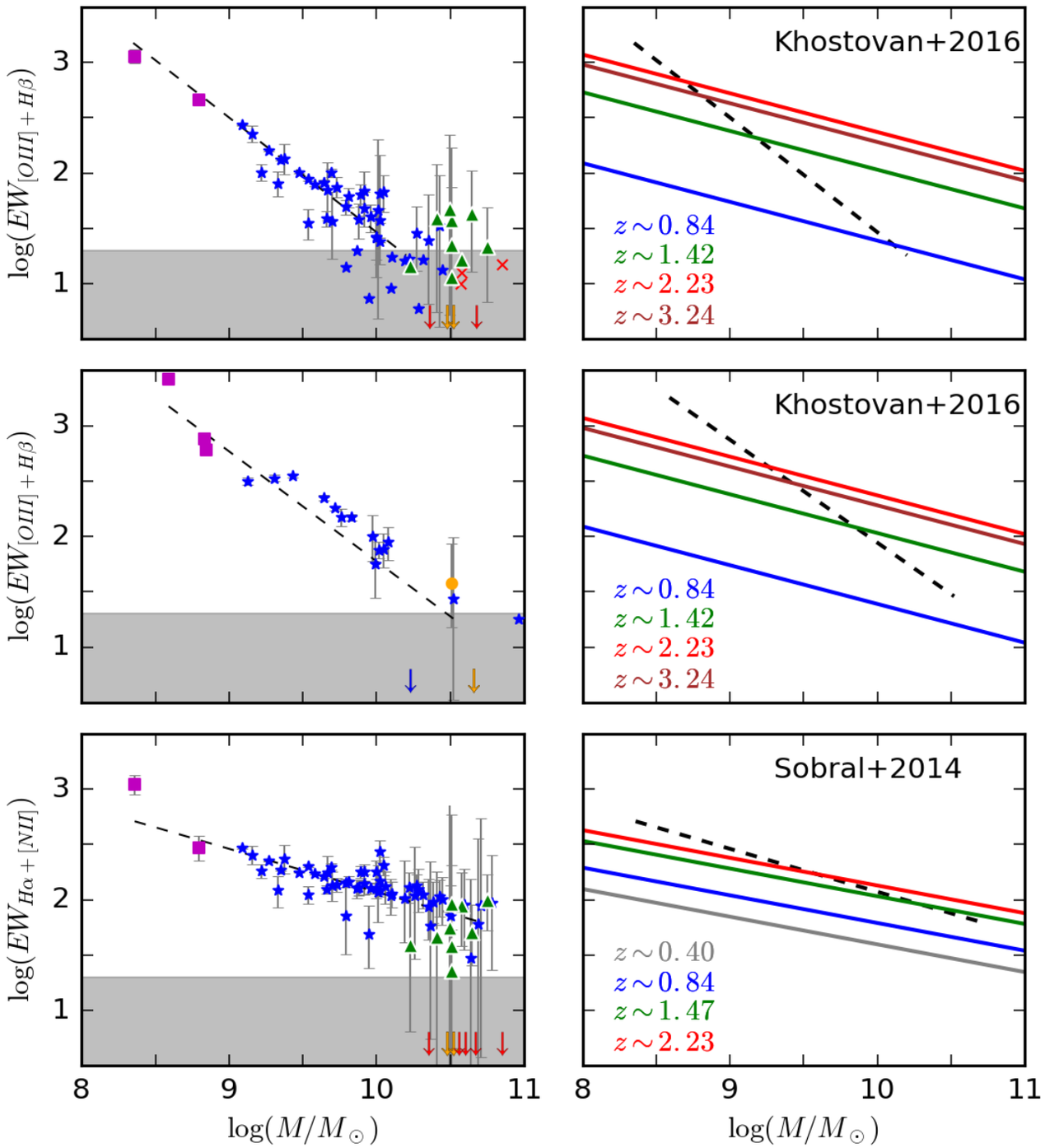
# Example Composite SEDs



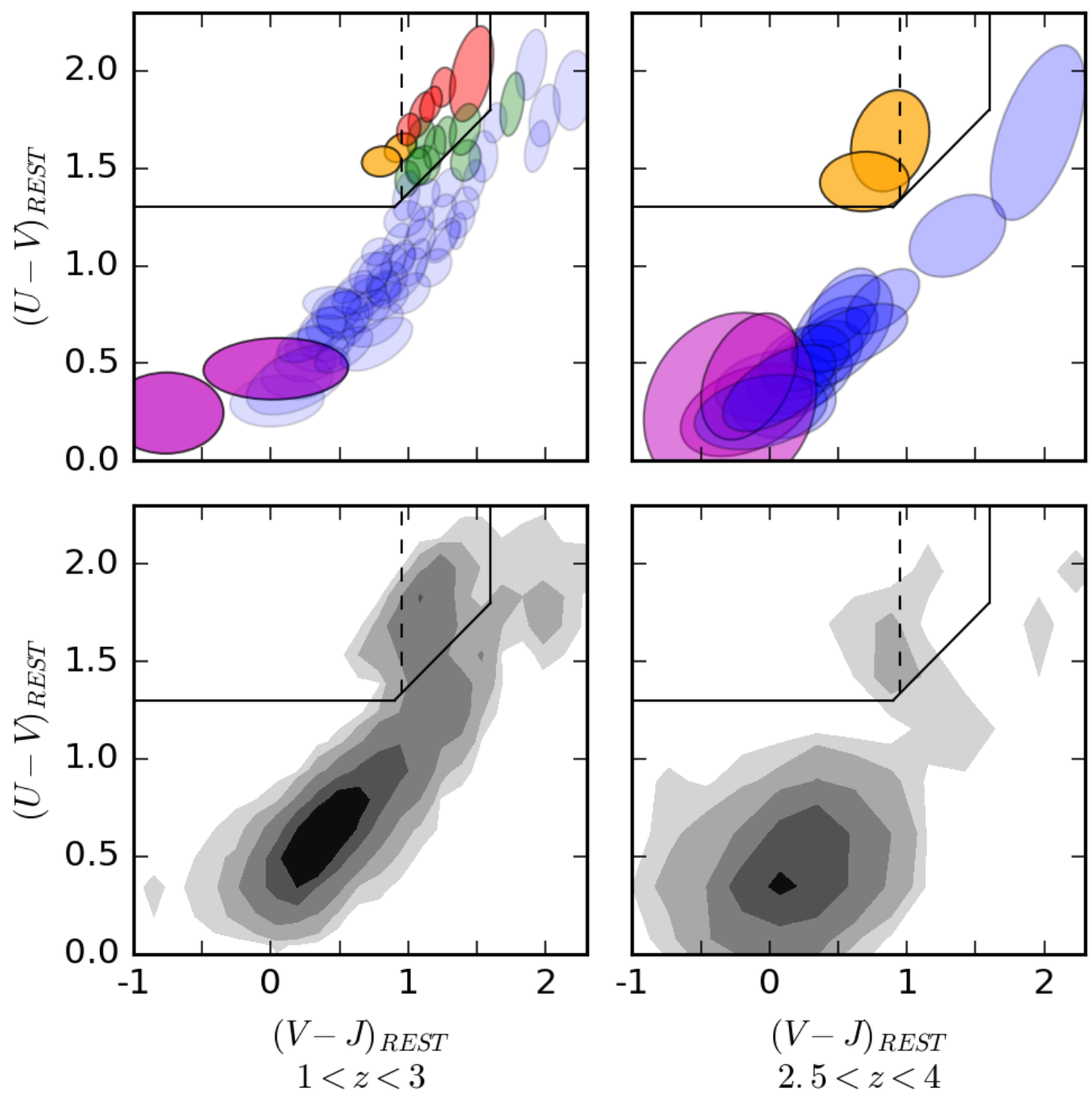
# Classification



# Equivalent Widths



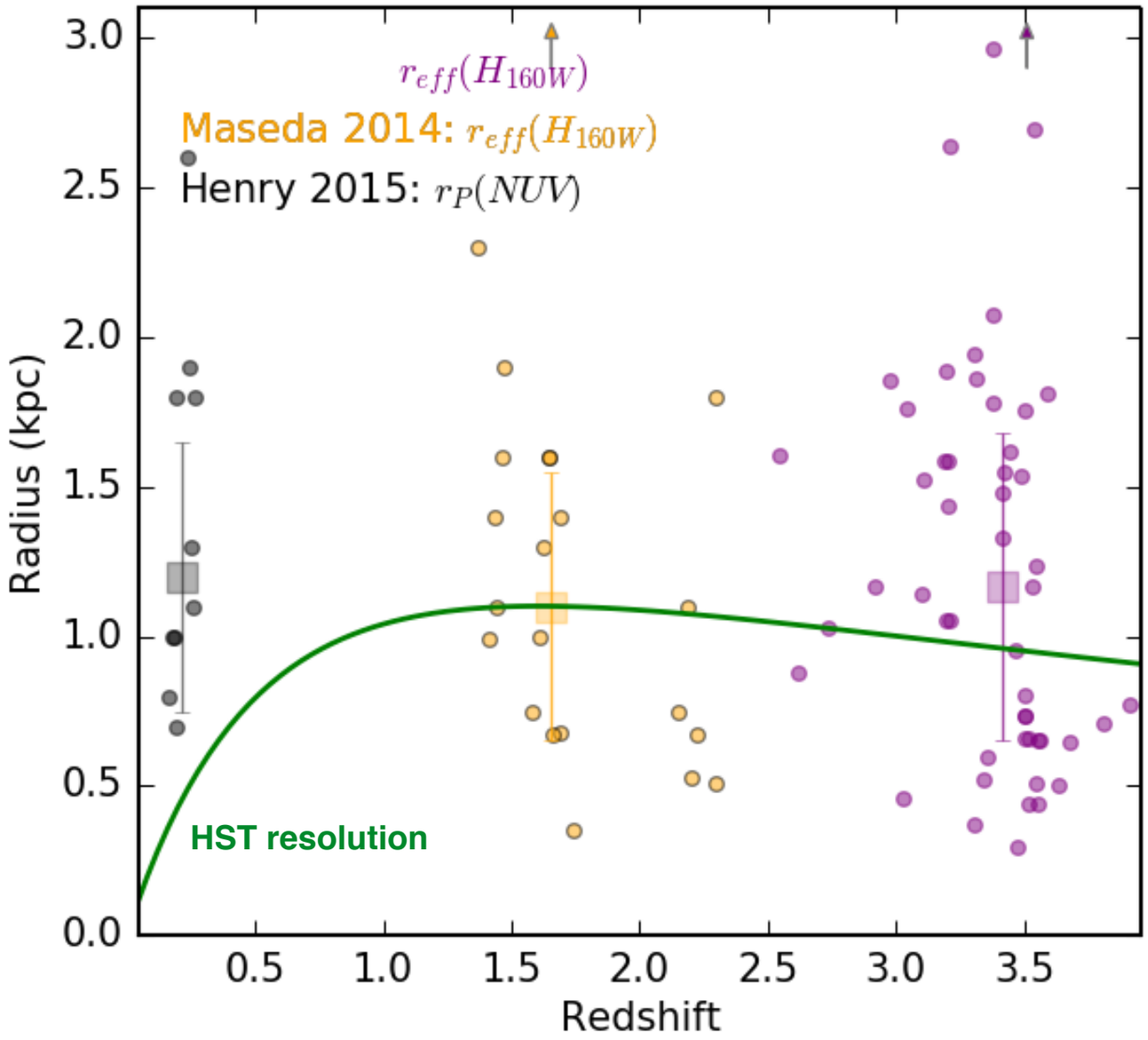
# The UVJ Diagram



# Extreme Emission Line Galaxies

**Table 1.** Properties of the ELG Population[a]

| | EELGs | SELGs |
|---|---|---|
| $\log(M_*/M_\odot)$ | $8.65^{+0.23}_{-0.30}$ | $9.06^{+0.26}_{-0.29}$ |
| $\log(\mathrm{age/yr})$ | $7.22^{+0.08}_{-0.32}$ | $7.52^{+0.38}_{-0.32}$ |
| $\log(\tau/\mathrm{yr})$ | $7.67^{+1.03}_{-0.67}$ | $7.32^{+0.28}_{-0.32}$ |
| SFR $(M_\odot/\mathrm{yr})$ | $24.4^{+15.0}_{-14.8}$ | $17.61^{+11.9}_{-12.0}$ |
| $\mathrm{A_V(mag)}$ | $0.45^{+0.20}_{-0.25}$ | $0.46^{+0.19}_{-0.21}$ |
| $r_e$[b] (kpc) | $1.34^{+0.52}_{-0.74}$ | $1.62^{+0.65}_{-0.84}$ |
| $EW_{[OIII]+H\beta}$[c] (Å) | $803 \pm 228$ | $230 \pm 90$ |

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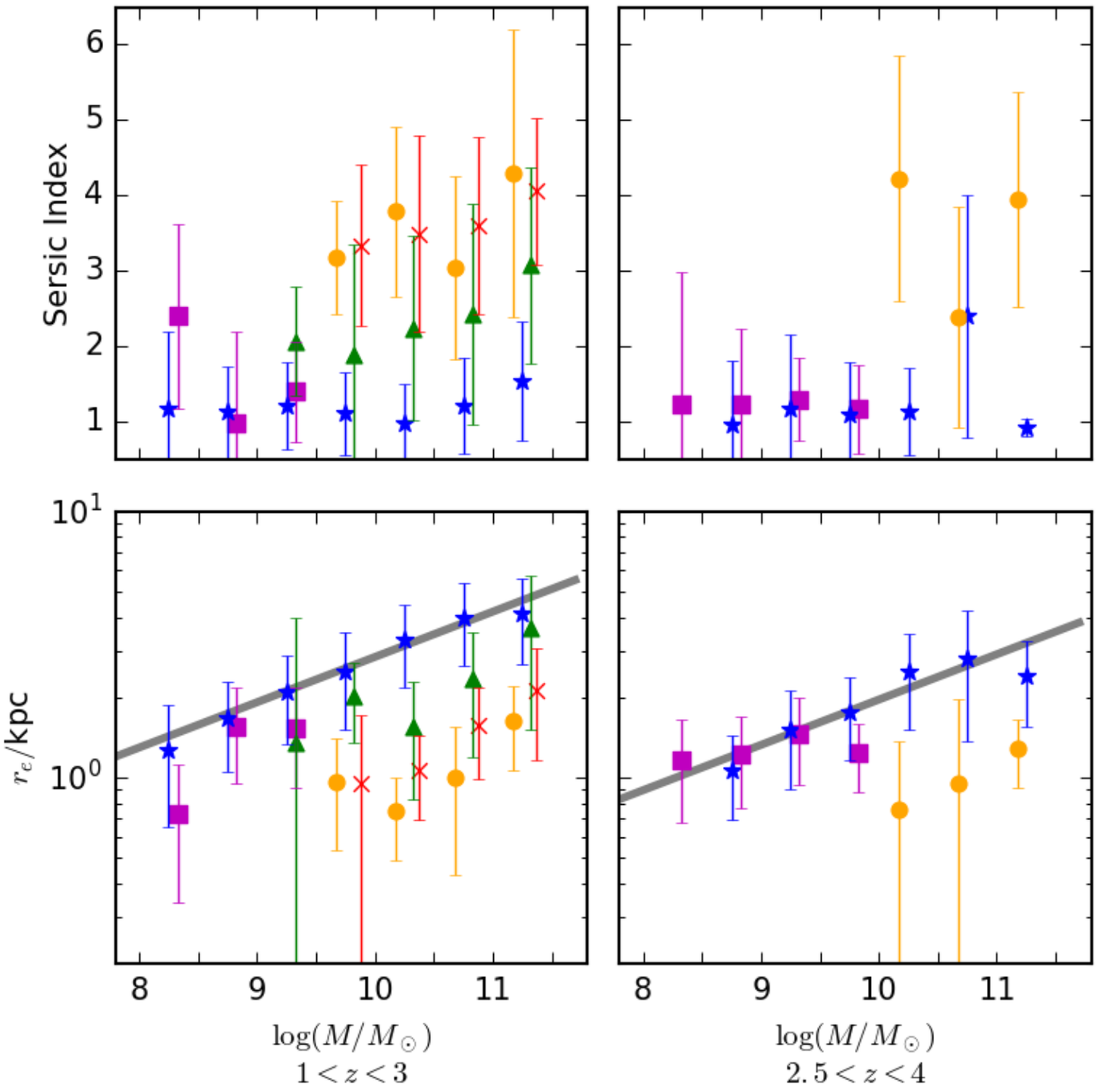
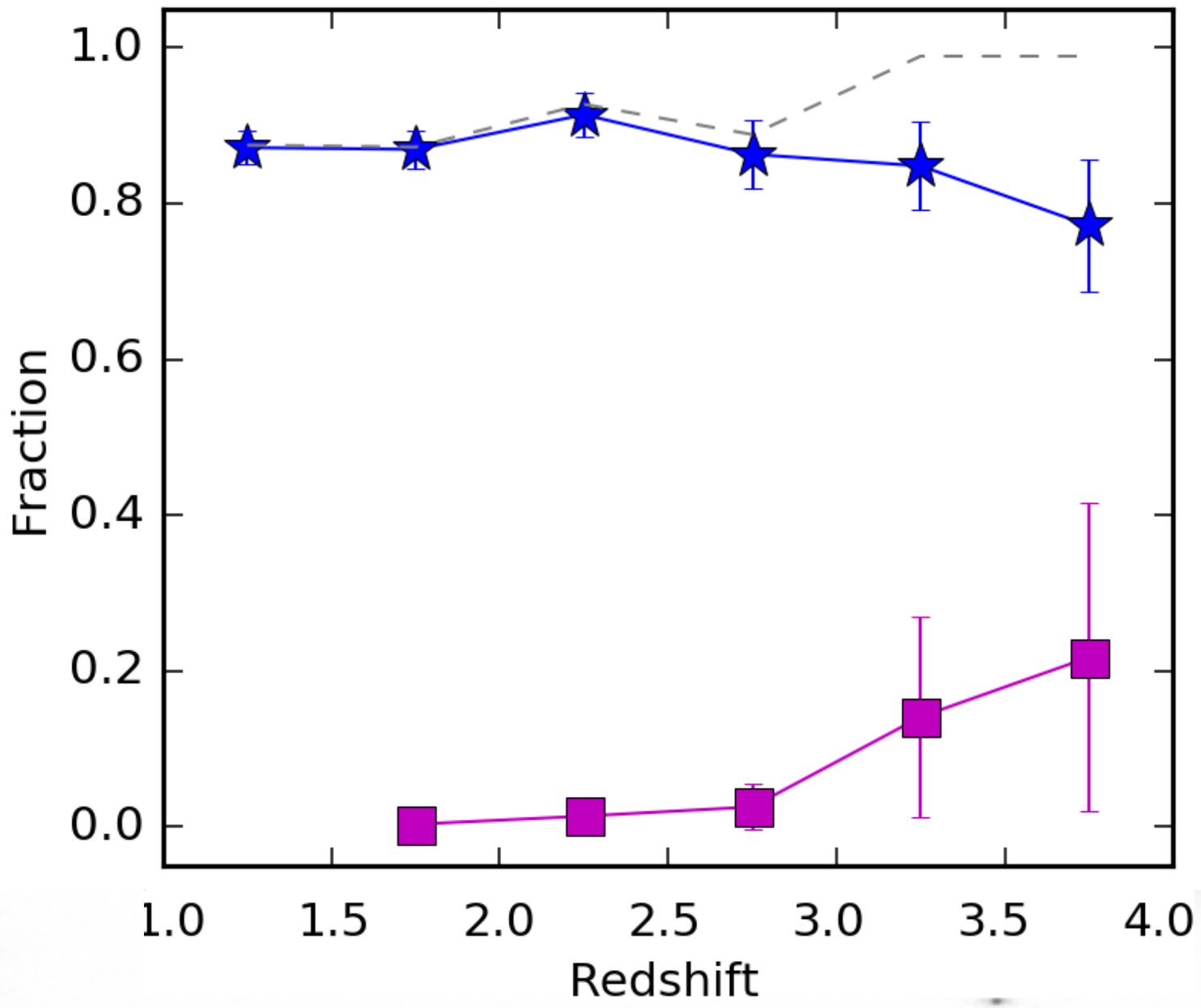
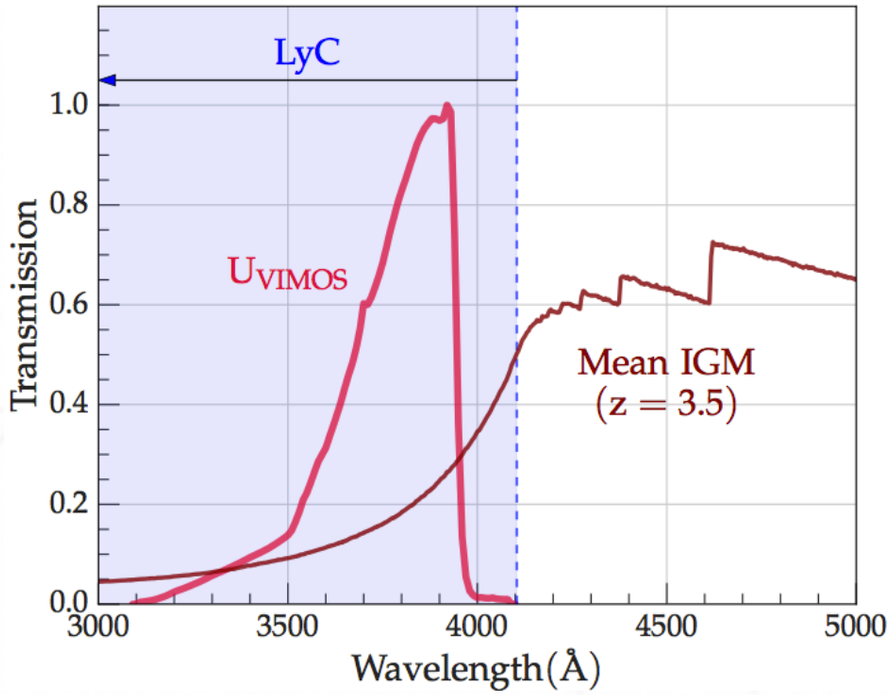
# Small Sizes

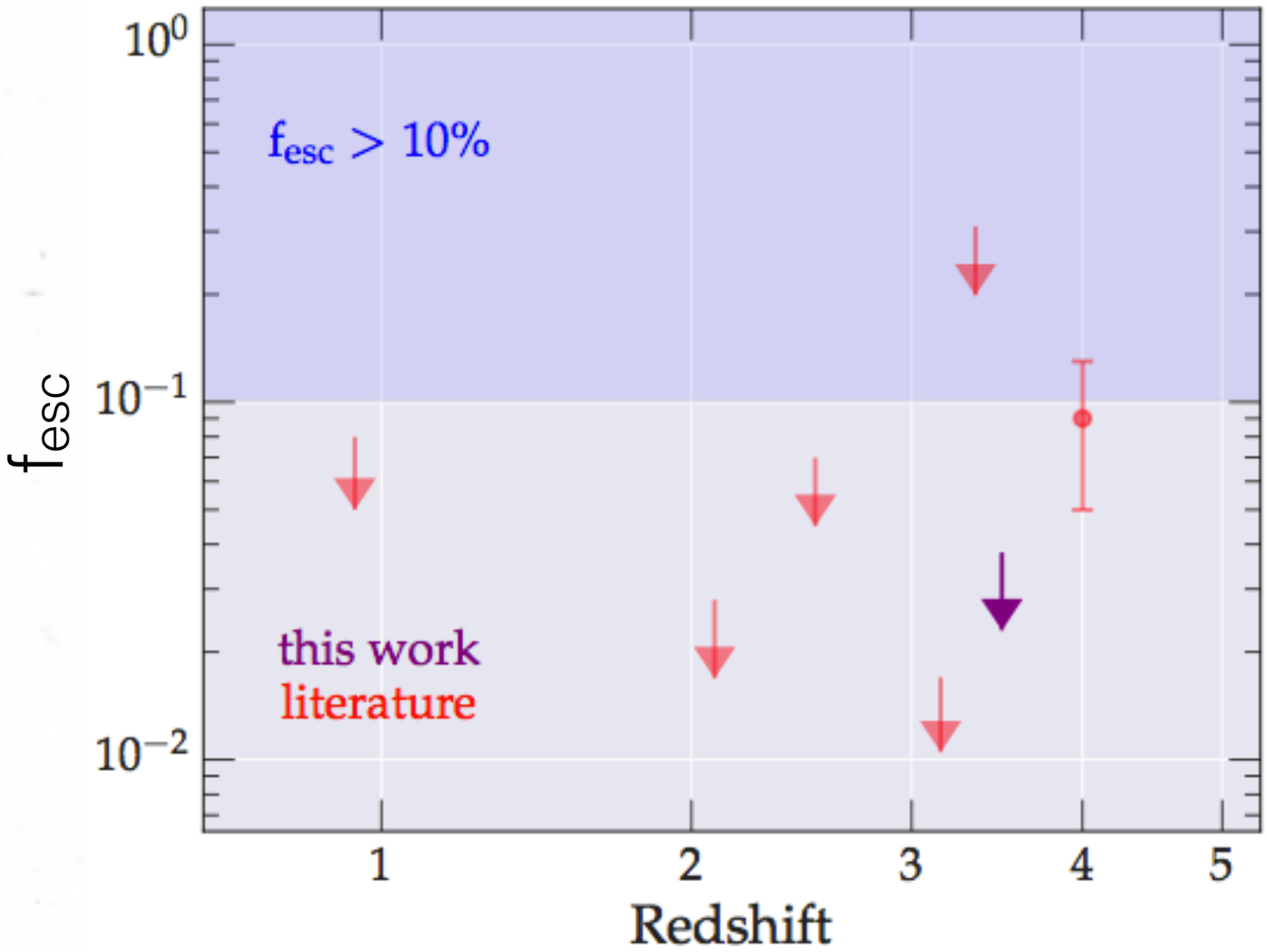

Sersic Index
6
5
4
3
2
1
$10^1$
$10^0$
$r_e$/kpc
8
9
10
11
$\log(M/M_\odot)$
$1 < z < 3$
$\log(M/M_\odot)$
$2.5 < z < 4$

# More Common



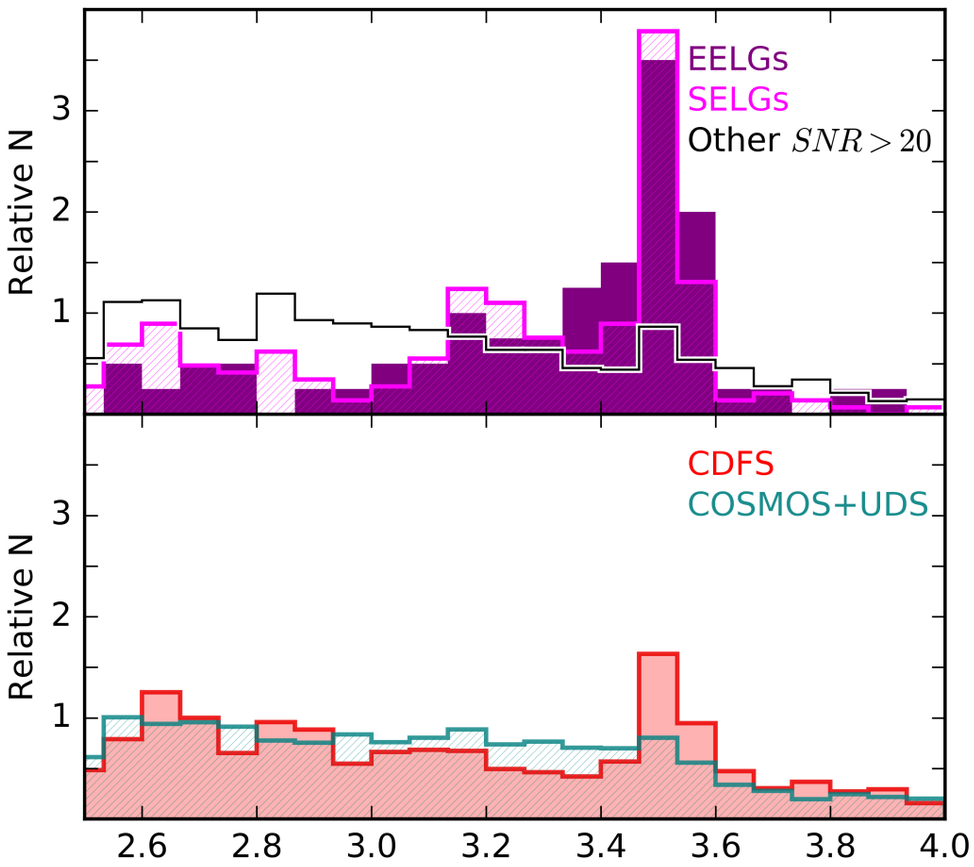
# Escape Fraction

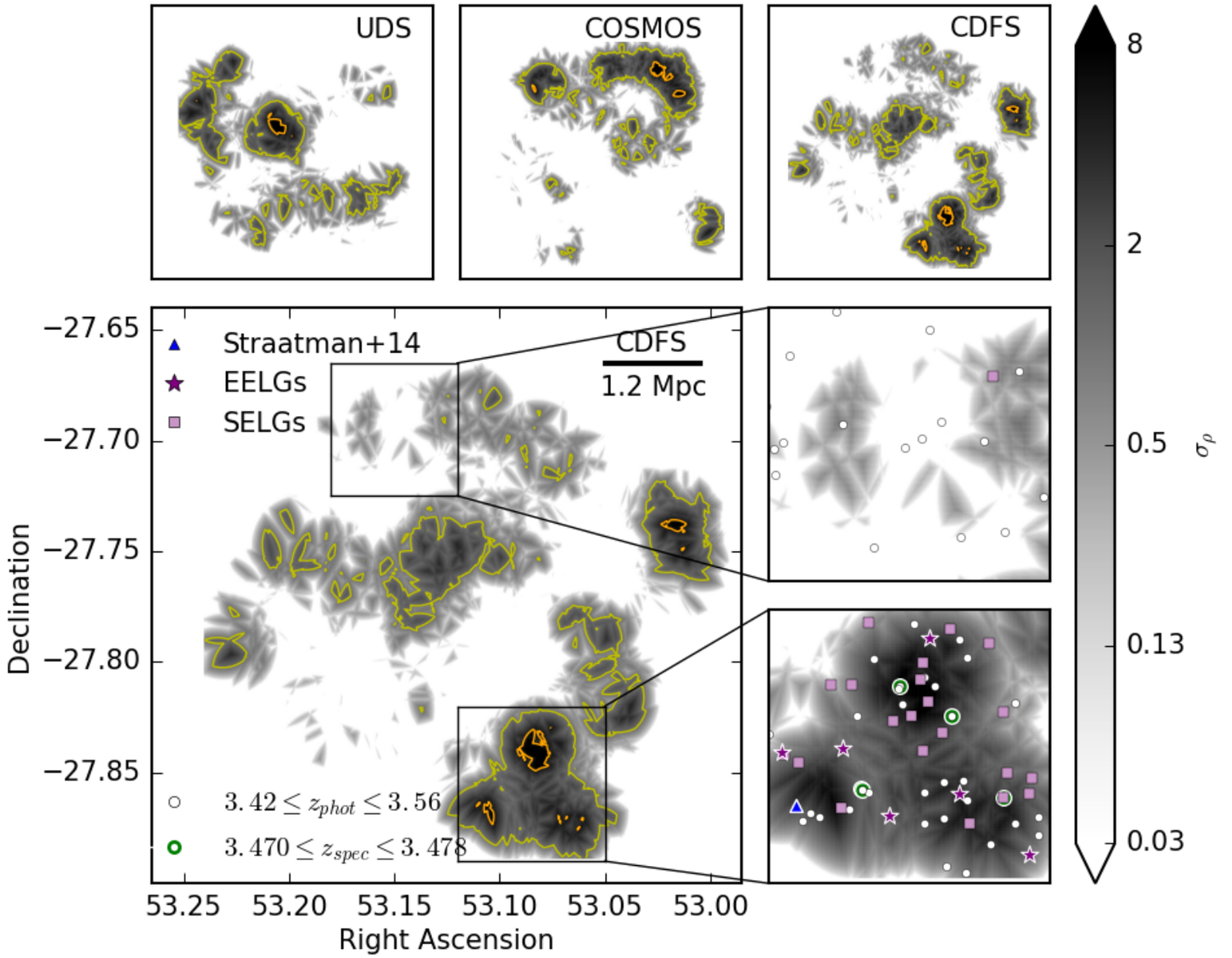



Naidu+, submitted

# Structure in CDFS at z~3.5

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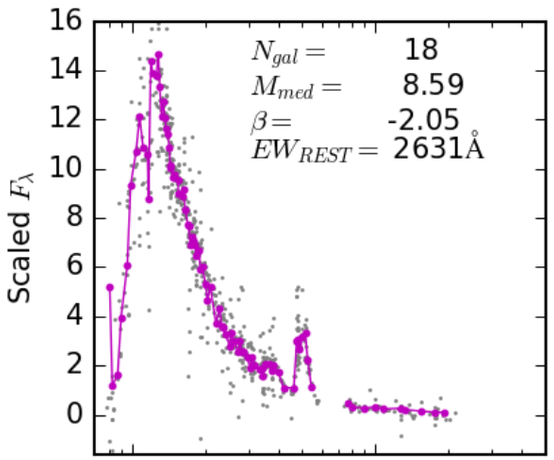
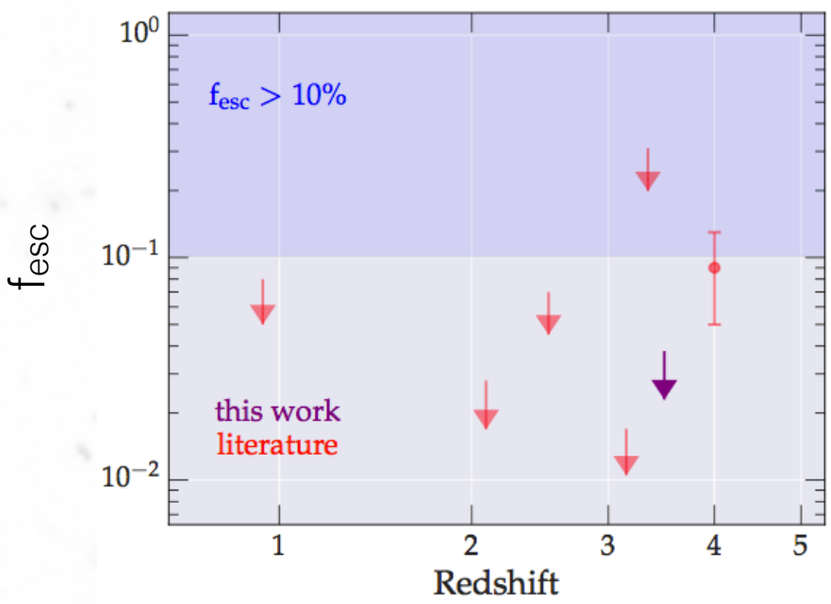
# Conclusions

- Composite SEDs are a great way to find rare populations in large photometric datasets.

- Galaxies with EW([OIII]+Hβ)>0.1 μm are increasingly common at higher redshifts - however they likely are not the sole contributor to reionization.

- Spectroscopic follow-up of EELGs in the MOSEL survey (talk this p.m. by Vy Tran).



# Acknowledgements

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# Questions?