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

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19 September, 2017
Many-color selection of EELGs through Composite SED Construction from the ZFOURGEG Catalogs

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(Last Talk before Coffee)
Many-colour selection of EELGs through Composite SED Construction from the Zed-FOURGE Catalogues

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(Last Talk before Coffee) Tea
Outline

0. ZFOURGE
1. Construction of Composite SEDs
2. Classification
3. Properties
ZFOURGE

Redshift

Flux / Hz

wavelength (micron)

Medium-Band

J1, J2, J3, Hβ, Hα

Broad-Band

J, H

zfourge.tamu.edu
Adam Tomczak
ZFOURGE

Redshift

 Flux / Hz

wavelength (micron)

wavelength (micron)

zfourge.tamu.edu
Adam Tomczak
40 photometric measurements
EAZY Templates

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

- 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.

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

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

Method pioneered in Kriek+2011
Building Composite SEDs

![Graphs showing observed and de-redshifted photometry and composite of ~130 galaxies]
Building Composite SEDs

- Observed Photometry
- De-redshifted Photometry
- De-redshifted and Scaled Photometry
- Composite of ~130 Galaxies
Building Composite SEDs

- Observed Photometry
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Building Composite SEDs

- Observed Photometry
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- De-redshifted and Scaled Photometry
- Composite of ~130 Galaxies
Example Composite SEDs

Forrest+16
Example Composite SEDs

\[ N_{gal} = 18 \]
\[ M_{med} = 8.59 \]
\[ \beta = -2.05 \]
\[ EW_{REST} = 2631\text{Å} \]

\[ N_{gal} = 63 \]
\[ M_{med} = 8.84 \]
\[ \beta = -2.00 \]
\[ EW_{REST} = 755\text{Å} \]

\[ N_{gal} = 36 \]
\[ M_{med} = 9.76 \]
\[ \beta = -1.56 \]
\[ EW_{REST} = 148\text{Å} \]

\[ N_{gal} = 26 \]
\[ M_{med} = 9.97 \]
\[ \beta = -1.49 \]
\[ EW_{REST} = 100\text{Å} \]
Classification
Equivalent Widths

\begin{align*}
\log(EW_{\text{HI} + \beta}) & \quad \log(M/M_\odot) \\
\log(EW_{\text{HI} + \beta}) & \quad \log(M/M_\odot) \\
\log(EW_{H_\alpha + \beta}) & \quad \log(M/M_\odot)
\end{align*}
The UVJ Diagram
Extreme Emission Line Galaxies

Table 1. Properties of the ELG Population\textsuperscript{a}

<table>
<thead>
<tr>
<th></th>
<th>EELGs</th>
<th>SELGs</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \log(M_*/M_\odot) )</td>
<td>(8.65^{+0.23}_{-0.30} )</td>
<td>(9.06^{+0.26}_{-0.29} )</td>
</tr>
<tr>
<td>( \log(\text{age/yr}) )</td>
<td>(7.22^{+0.08}_{-0.32} )</td>
<td>(7.52^{+0.38}_{-0.32} )</td>
</tr>
<tr>
<td>( \log(\tau/\text{yr}) )</td>
<td>(7.67^{+1.03}_{-0.67} )</td>
<td>(7.32^{+0.28}_{-0.32} )</td>
</tr>
<tr>
<td>SFR ( (M_\odot/\text{yr}) )</td>
<td>(24.4^{+15.0}_{-14.8} )</td>
<td>(17.61^{+11.9}_{-12.0} )</td>
</tr>
<tr>
<td>( A_V ) (mag)</td>
<td>(0.45^{+0.20}_{-0.25} )</td>
<td>(0.46^{+0.19}_{-0.21} )</td>
</tr>
<tr>
<td>( r_e ) (kpc)</td>
<td>(1.34^{+0.52}_{-0.74} )</td>
<td>(1.62^{+0.65}_{-0.84} )</td>
</tr>
<tr>
<td>( EW_{[O III]+H_\beta} ) (Å)</td>
<td>(803 \pm 228 )</td>
<td>(230 \pm 90 )</td>
</tr>
</tbody>
</table>

Forrest+17

\textsuperscript{a} Maseda 2014: \( r_{\text{eff}}(H_{160W}) \)

Henry 2015: \( r_P(NUV) \)
Small Sizes

\[ \begin{align*}
\text{Sersic Index} & \quad \log(M/M_\odot) \\
\text{1} < z < 3 & \quad 8 < 9 < 10 < 11 \\
\end{align*} \]

\[ \begin{align*}
\text{r}_e \text{ (kpc)} & \quad \log(M/M_\odot) \\
2.5 < z < 4 & \quad 8 < 9 < 10 < 11 \\
\end{align*} \]
More Common

![Graph showing the relationship between Redshift and Fraction. The graph displays a trend where the fraction increases with increasing redshift.]
Escape Fraction

Naidu+, submitted
Structure in CDFS at $z \sim 3.5$

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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).
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