

Extreme Emission Line Galaxies at $z < 0.05$

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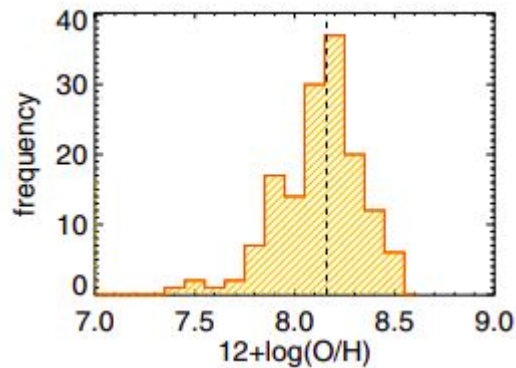
15th Collaboration S-PLUS Meeting
June/2021



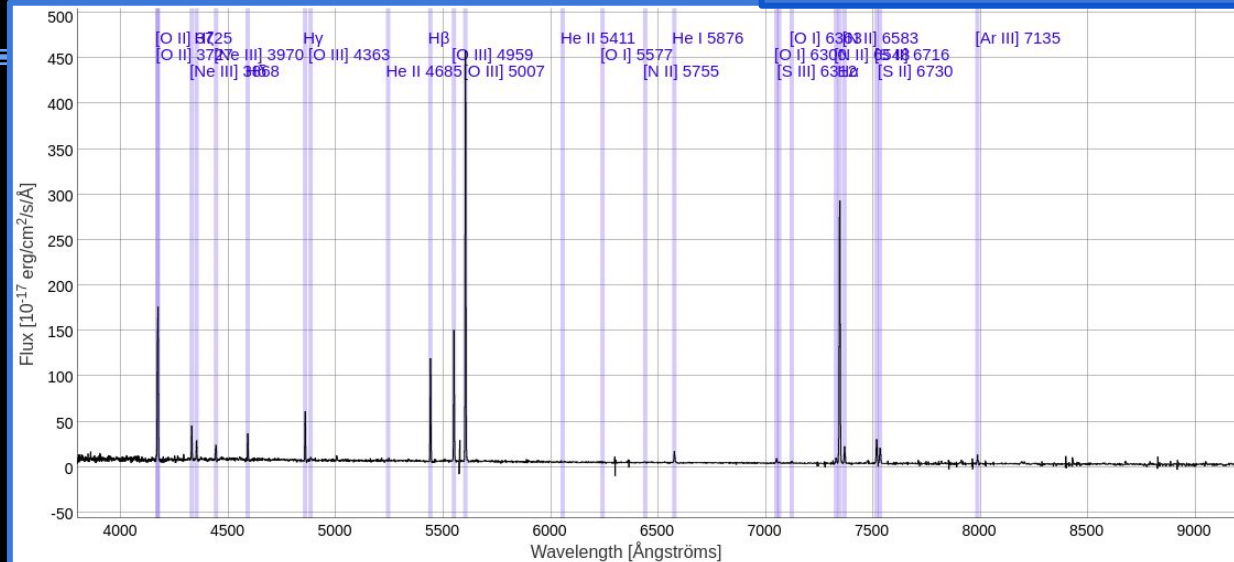
Extreme emission line galaxies

- Spectra characterized by strong emission lines, i.e. $EW([OIII]) > 200\text{\AA}$ ou $EW(H\alpha) > 200\text{\AA}$.
- Low mass galaxies
- Low metallicity
- High specific star formation rate ($sSFR = SFR/M \sim 10^{-7} \text{ yr}$)
- Compact objects

SDSS J214459.58-001140.2

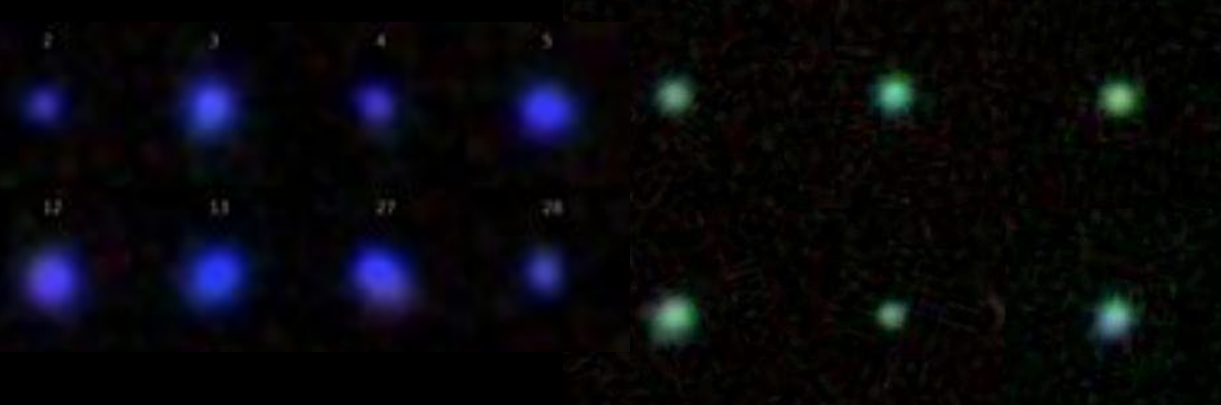


Amorín et al. (2015)



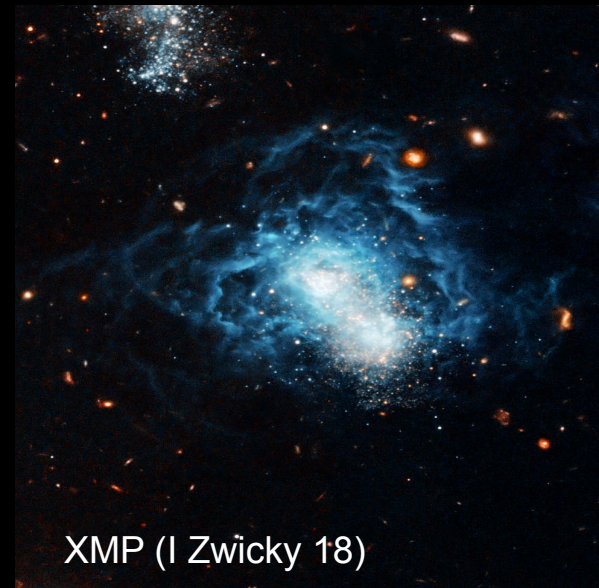
Local Analogs of high-z galaxies

- Low metallicity
- High specific star formation rate ($sSFR = SFR/M \sim 10^{-7}$ yr)
- High ionization
- Simplest starbursts in local in galactic scale with the highest SF efficiencies



Blueberries
(Yang et al. 2017)

Green Peas
(Cardamone et al. 2009)



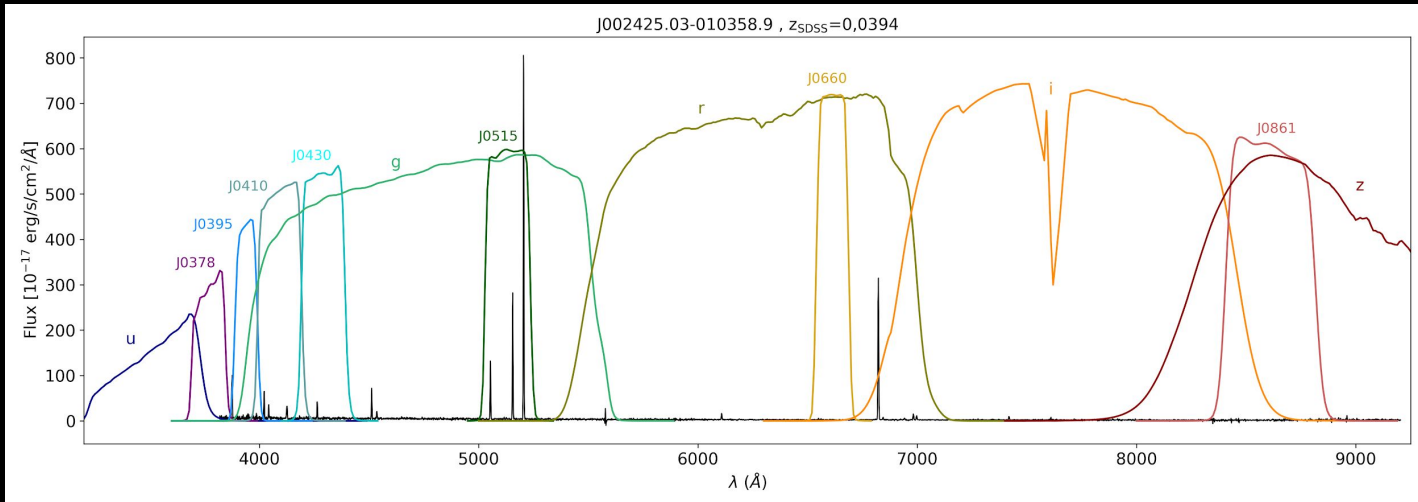
XMP (I Zwicky 18)

Project goals

- Select EELG candidates at different z-ranges
 - + $H\alpha$ at J0660 ($z < 0.016$), J0861 ($0.285 < z < 0.36$)
 - + $[OIII]$ at J0515 ($0.008 < z < 0.05$), J0660 ($0.323 < z < 0.332$)
- Characterize EELG candidates (estimate line fluxes, SFR, perform SED-fitting...)
- Select best candidates for spectroscopic follow-up

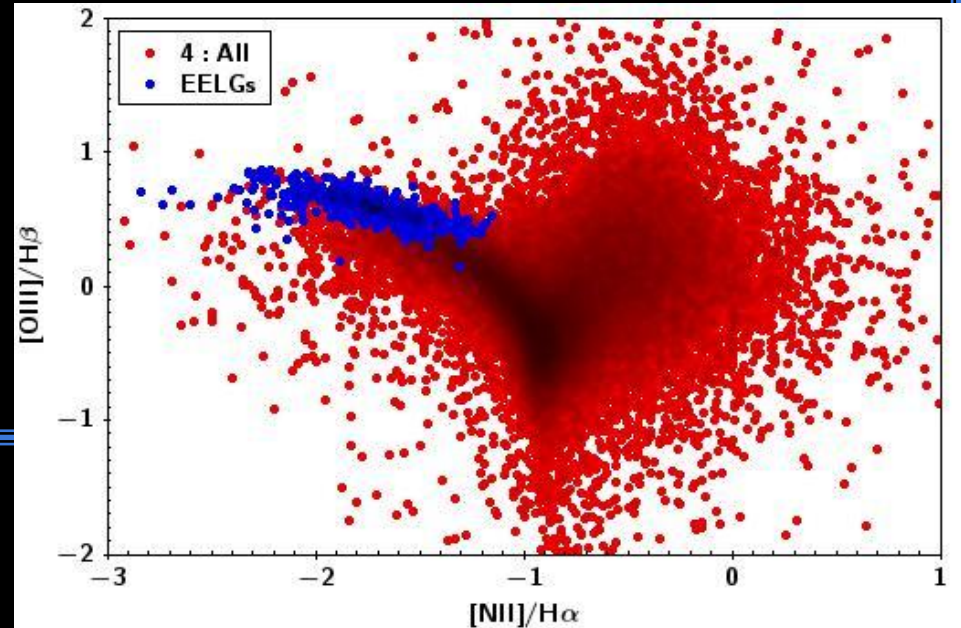
How to identify EELGs?

- Excess in a narrow band indicate the presence of a emission line
- Locate using color-color plots
- **Keep in mind: high-z interlopers at J0515** (different emission lines at different z)
 - + Mg II at $z\sim 0.8$; C III] at $z\sim 1.7$; C IV at $z\sim 2.3$; Ly α at $z\sim 3.2$



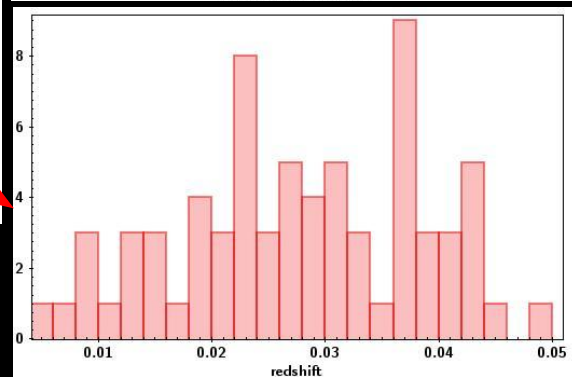
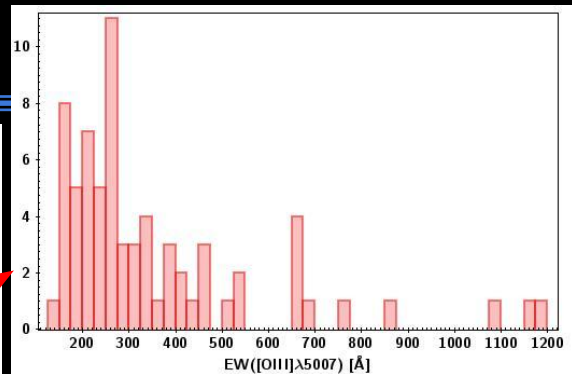
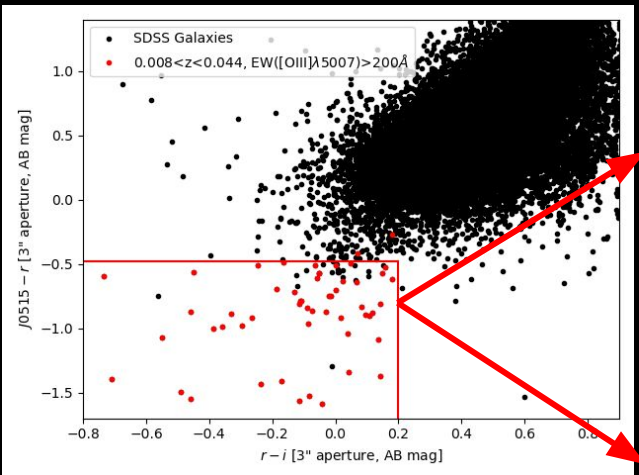
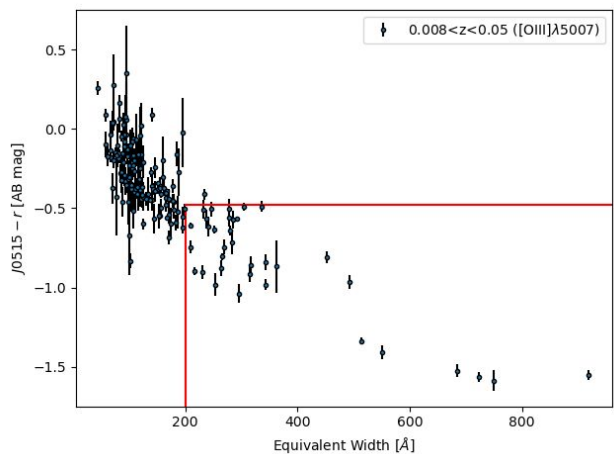
EELGs selection

- SDSS DR16 spectroscopic sample:
 - + emissionLinePort + galSpecLine tables
 - + Cross-match with SPLUS DR2 + PhotoFlag<4: 77210
- From known [OIII] EELGs:
 - + eliminate subclass=AGN
 - + $z > 0.005$
 - + $EW(H\beta) > 30\text{\AA}$
 - + $EW([OIII]) > 100\text{\AA}$
 - + $EW(H\alpha) > 100\text{\AA}$
 - + Total of 427 galaxies
 - + Missing ~290 galaxies in S-PLUS



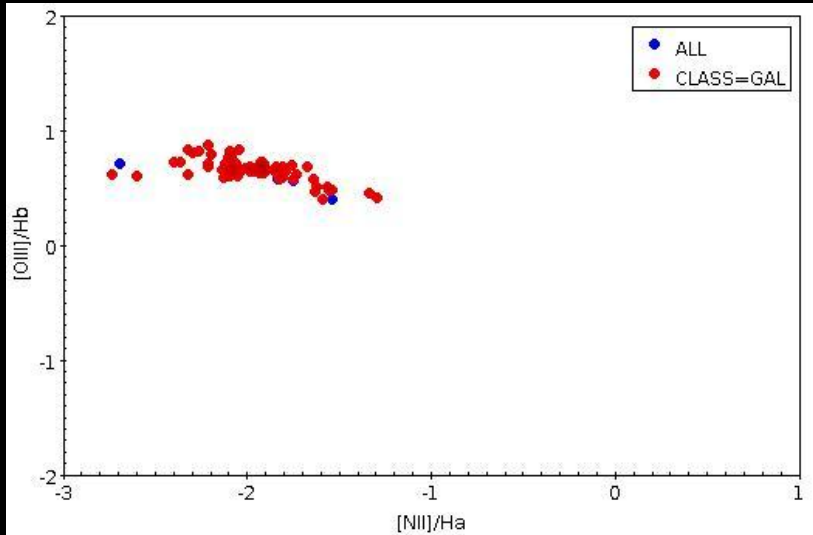
EELGs selection

- From known [OIII] EELGs at $0.008 < z < 0.044$ and $\text{EW}([\text{OIII}]) > 200$:
 - + $J0515-r < -0.48$; $r-i < 0.2$; $g-J0515 > 0.5$; $g-r < 0.4$
 - + Testing to whole spec sample: 71 objects selected

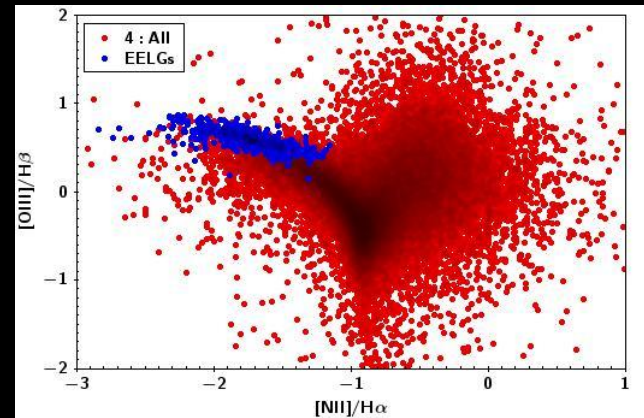


EELGs selection

- From known [OIII] EELGs:
 - + $J0515-r < -0.48$; $r-i < 0.2$; $g-J0515 > 0.5$; $g-r < 0.4$
 - + Testing to whole spec sample: 70 objects selected
 - + From S-PLUS classification: 65 galaxies, 3 star and 2 QSOs
 - + Wrong classification due to PhotoFlag=3



recover



Line emission flux estimates

- Three filter method (Pascual et al. 2007, Guaita et al. 2010, Vilella-Rojo et al. 2015):

$$F_{\text{line}} = \frac{(f_{\text{obs}}^{\text{BBC}} - f_{\text{obs}}^{\text{BBU}}) + \left(\frac{\alpha_{\text{BBU}} - \alpha_{\text{BBC}}}{\alpha_{\text{NB}} - \alpha_{\text{BBU}}} \right) (f_{\text{obs}}^{\text{NB}} - f_{\text{obs}}^{\text{BBU}})}{\beta_{\text{NB}} \left(\frac{\alpha_{\text{BBU}} - \alpha_{\text{BBC}}}{\alpha_{\text{NB}} - \alpha_{\text{BBU}}} \right) + \beta_{\text{BBC}}}$$

where:

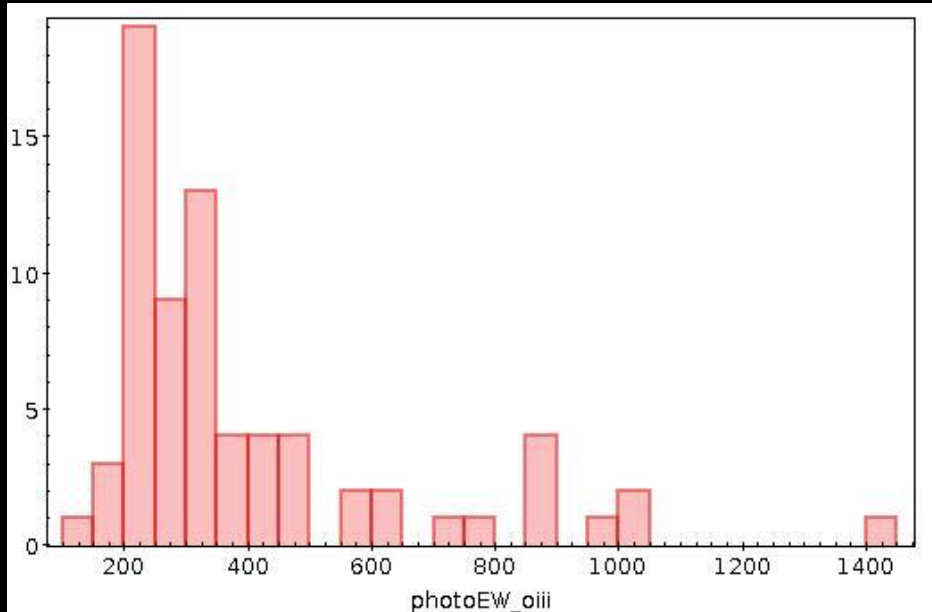
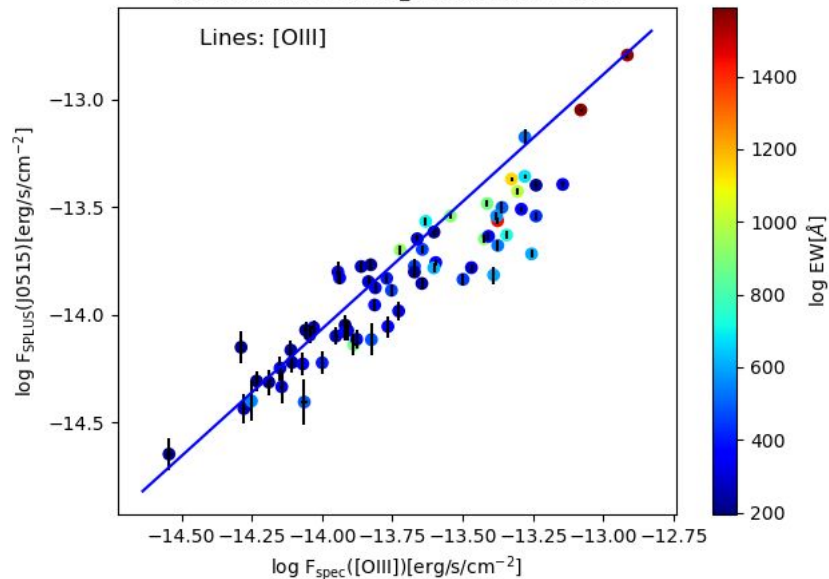
$$\alpha_{\text{band}} = \frac{\int \lambda^2 T_{\text{band}}(\lambda) d\lambda}{\int T_{\text{band}}(\lambda) \lambda d\lambda} \quad \text{and} \quad \beta_{\text{band}} = \frac{\lambda_{\text{EL}} T_{\text{band}}(\lambda_{\text{EL}})}{\int T_{\text{band}}(\lambda) \lambda d\lambda}$$

Equivalent width: $EW = F_{\text{line}} / F_{\text{cont}}$ with $F_{\text{cont}} = A\lambda + B$

$$A = \frac{(f_{\text{obs}}^{\text{NB}} - f_{\text{obs}}^{\text{BBU}}) - \frac{\beta_{\text{NB}}}{\beta_{\text{BBC}}} (f_{\text{obs}}^{\text{BBC}} - f_{\text{obs}}^{\text{BBU}})}{\alpha_{\text{NB}} - \alpha_{\text{BBU}} - \frac{\beta_{\text{NB}}}{\beta_{\text{BBC}}} (\alpha_{\text{BBC}} - \alpha_{\text{BBU}})} \quad \text{and} \quad B = f_{\text{obs}}^{\text{BBU}} - \alpha_{\text{BBU}} A$$

Test results from line emission flux and EW

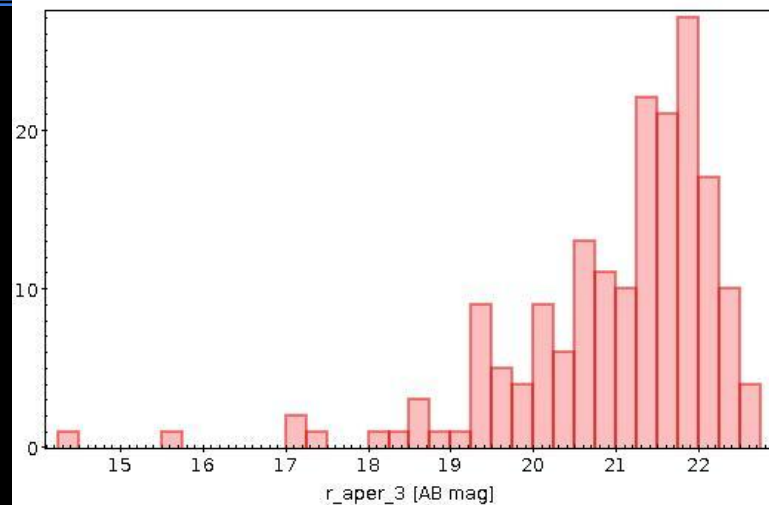
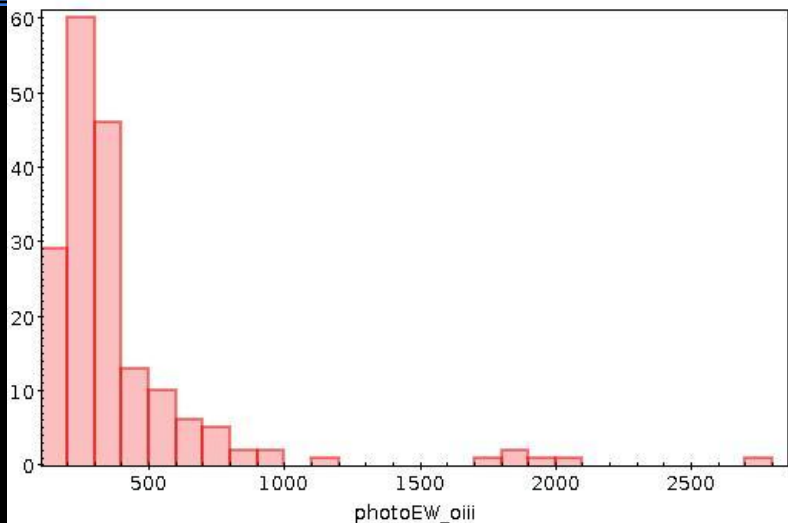
67 Galaxies from SPLUS_DR2 at $0.008 < z < 0.05$



Candidate EELG selection in Stripe82

For 170 fields :

- + PhotoFlag < 4 ; magnitude errors < 0.3
- + J0515-r < -0.48 ; r-i < 0.2 ; g-J0515 > 0.5 ; g-r < 0.4
- + S-PLUS classification: PROB_GAL > 0.5
- + Total: 246 objects \Rightarrow excluding known EELGs \Rightarrow 180 candidates



EELG candidates in Stripe82

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- + S-PLUS classification: PROB_GAL > 0.5
- + Total: 246 objects \Rightarrow excluding known EELGs \Rightarrow 180 candidates
- + $18 < r < 21.5 \Rightarrow$ **96 candidates**

EELG candidates in Stripe82

Searching in NED database:

- + 45 unique objects identified
- + 51 without match
- + From identified objects: 40 galaxies ; 1 UV source ; 4 IR source
only 2 galaxies with z_spec

EELG candidates in Stripe82

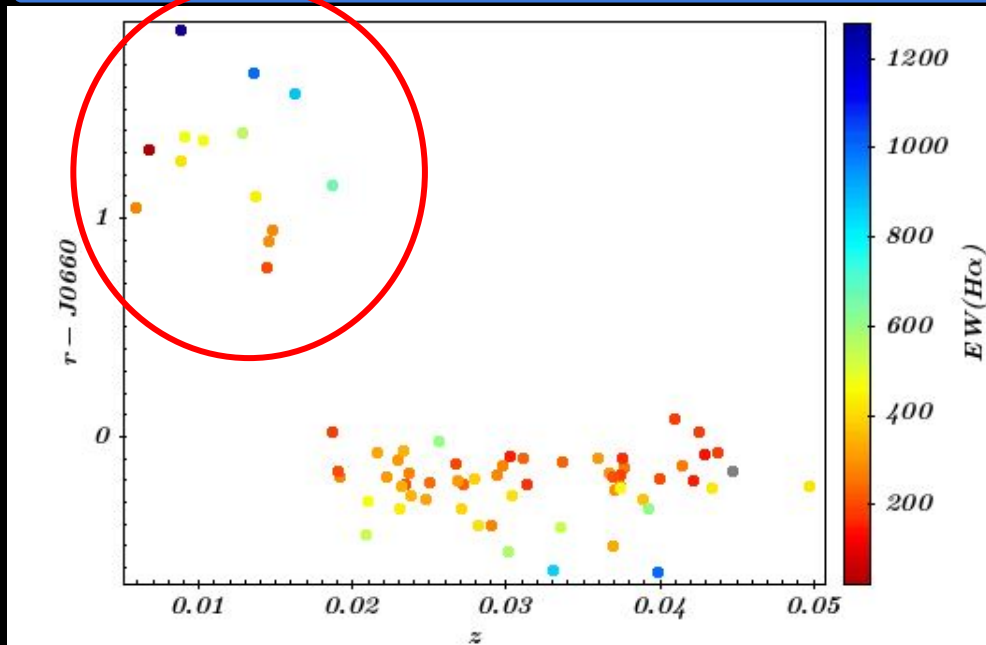
Some images for the candidates:



EELG candidates in Stripe82

If we wish to find $H\alpha$ at J0660 ($z < 0.016$) and [OIII] at J0515 ($0.008 < z < 0.05$):

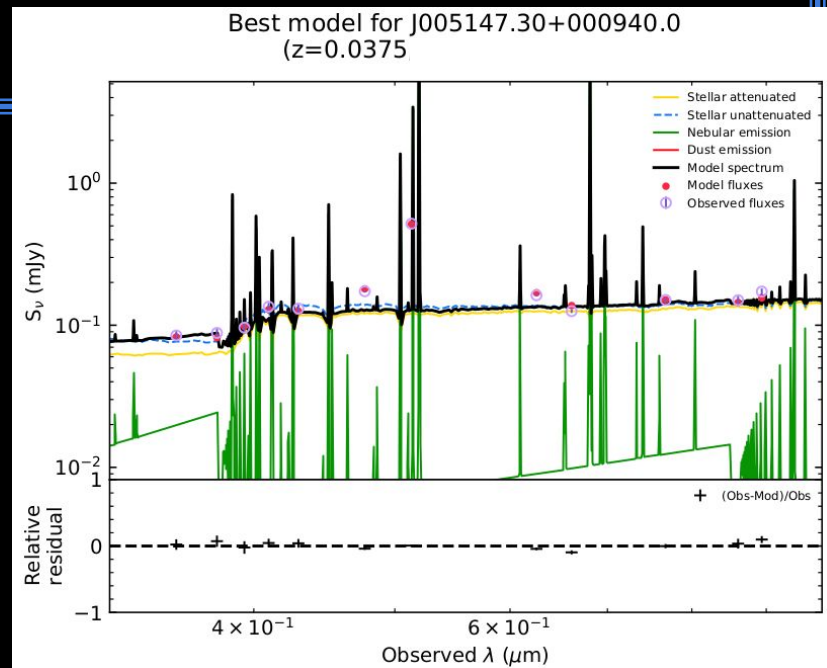
+ $r - J0660 < -0.5 \Rightarrow 23$ candidates



SED-fit for EELGs

Few experiments with CIGALE for 312 known EELGs

- + Chabrier IMF, BC03 models, 3 burst SFH
- + for EELGs at $0.008 < z < 0.05$, [OIII] contribution is well recover
- + 270 objects have GALEX and WISE data



Conclusions and perspectives

- So far, we selected 96 EELG candidates
- Next, we will select the best candidates for spectroscopic follow-up
- Characterize the candidates (mass, SFR, stellar populations,...)
- Extend the search EELGs for the whole footprint of S-PLUS
- Search for [OIII] EELGs at J0660 (Maybe!)
- Check how the narrow bands affect the SED-fitting of the EELGs

- Any comments, suggestions or questions:
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Thank you!