Extreme [OIII] emitters in S-PLUS

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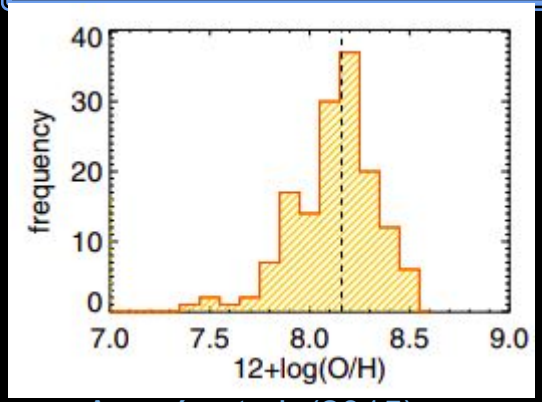
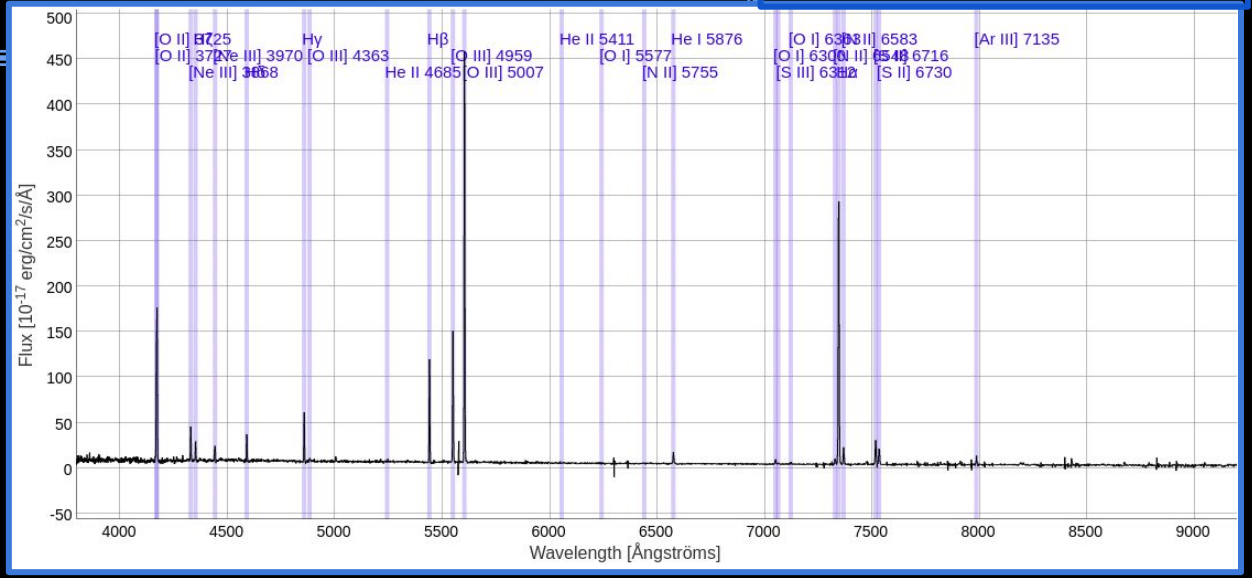
Extreme emission line galaxies

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



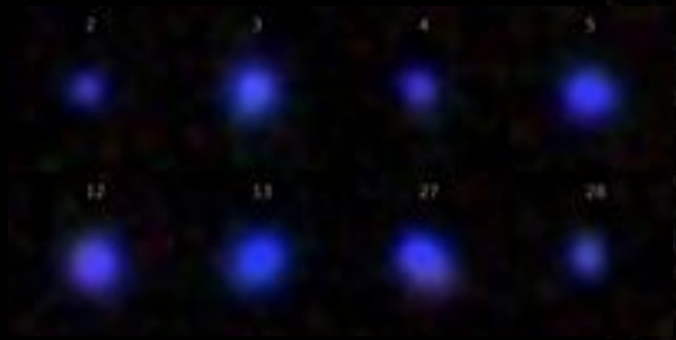
Amorín et al. (2015)

SDSS J214459.58-001140.2

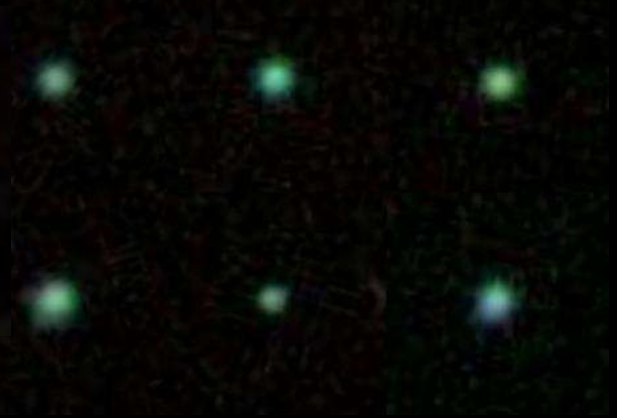


Local Analogs of high-z galaxies

- Low metallicity
- High specific star formation rate (sSFR = SFR/M ~ 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)

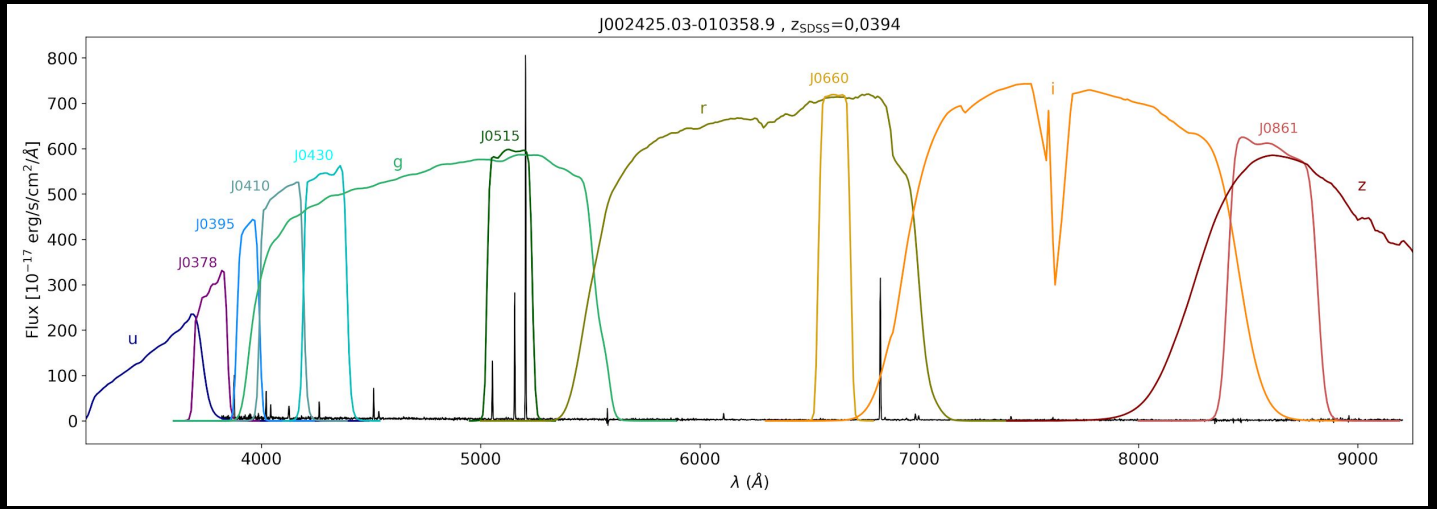
Project goals

- Select EELG candidates at different z-ranges
  - + Hα at J0660 (z<0.016), J0861 (0.285<z<0.036)
  - + [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

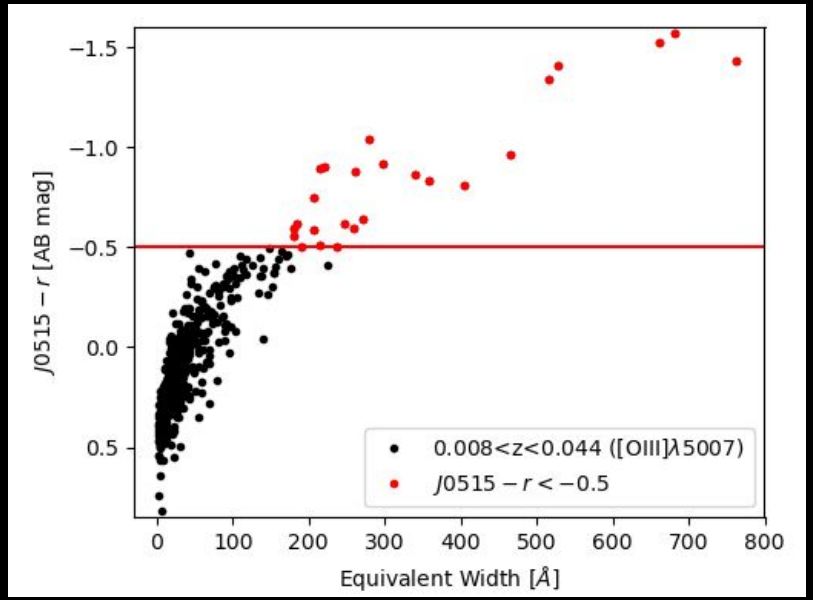
How to identify EELGs?

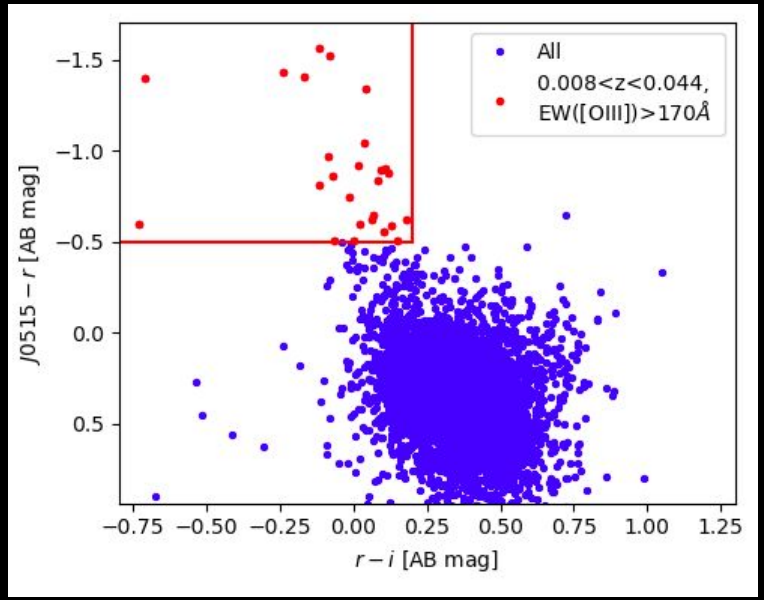
- Excess in a narrow band indicate the presence of a emission line
- Locate using color-color plots
- Keep in mind: high-z interlopers at J0515 (different emission lines at different z)
  + Mg II at z~0.8 ; C III] at z~1.7 ; C IV at z~2.3 ; Lyα at z~3.2



EELGs selection

- From known [OIII] EELGs:
  + J0515-r < -0.5 ; r-i < 0.18 ; g-J0515>0.5 ; J0430-J0515>0.5





Line emission flux estimates

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

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

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

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

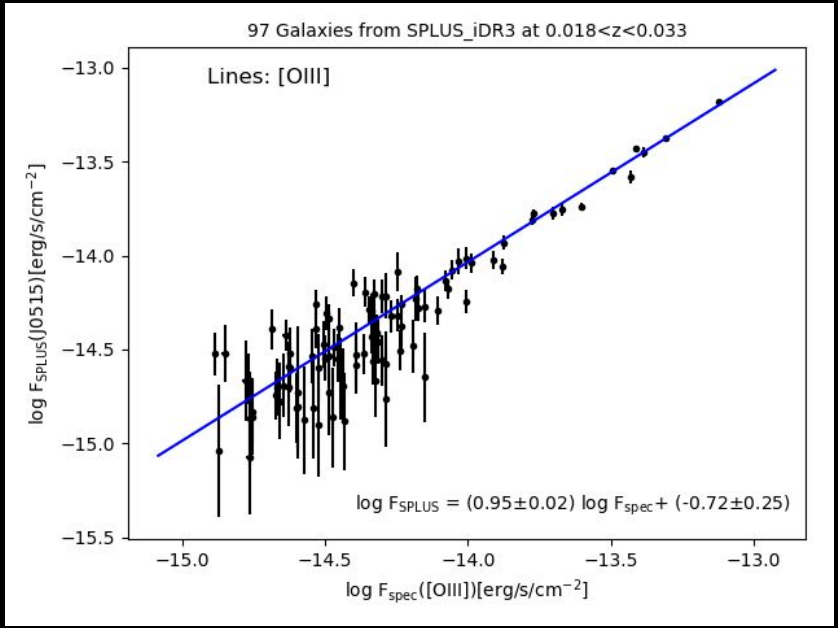
$$A = \frac{(f_{obs}^{NB} - f_{obs}^{BBU}) - \frac{\beta_{NB}}{\beta_{BBC}}(f_{obs}^{BBC} - f_{obs}^{BBU})}{\alpha_{NB} - \alpha_{BBU} - \frac{\beta_{NB}}{\beta_{BBC}}(\alpha_{BBC} - \alpha_{BBU})}$$ and $B = f_{obs}^{BBU} - \alpha_{BBU} A$

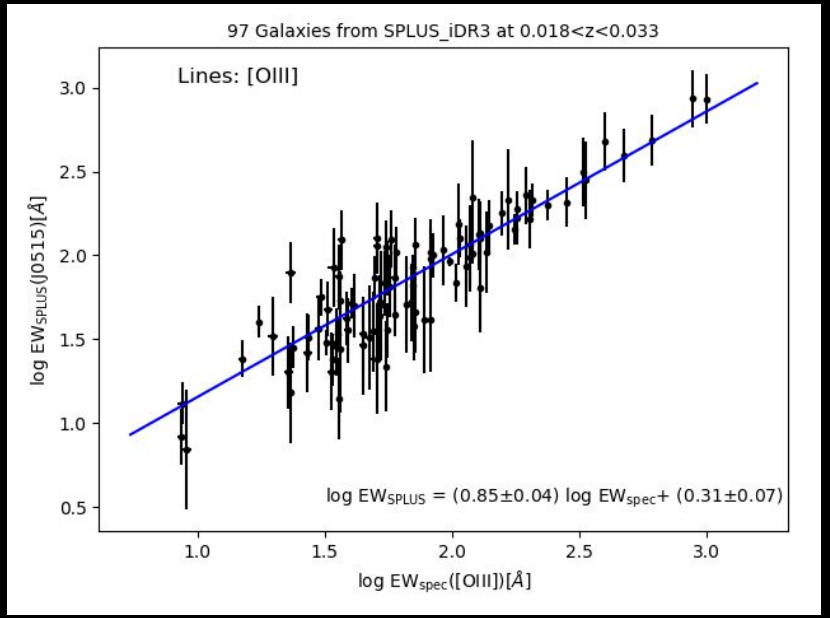
Code for Emission Line Analysis in Photometric Surveys

```
> python photoLineEmission.py -input initial

> python photoLineEmission.py -check lineEmission.ini

> python photoLineEmission.py -run lineEmission.ini
```

```
## CODE FOR EMISSION LINE ANALYSIS IN PHOTOMETRIC SURVEYS ##
# Input parameters

# Survey and data release number. Options: SPLUS_DR1, SPLUS_iDR3,
# JPLUS_DR1
survey = SPLUS_iDR3

# File containing the input data. It needs to be in .csv format. The
# file must include a column named 'ID' (id of the object). If such
# column is not found, one will be created based on TILE_ID and NUMBER
# columns. If TILE_ID and NUMBER columns are not found, an error message
# will be displayed. The photometric data must be included as
# 'band_datatype' (flux/magnitude in a given band) and 'e_band_datatype'
# (magnitude error in a given band). For example: 'F515_petro',
# 'e_F515_petro', 'J0660_petro', 'e_J0660_petro'. An exception is
# survey=SPLUS_DR1, where error columns are named as eband_datatype,
# e.g. eg_petro. If the spectroscopic redshift is available, it should
# be presented in a column named 'z'.
obs_data = test_SB_iDR3.csv

# Choose the type of included in the obs_data file: magnitude or flux.
# The magnitude units must be in AB mag and the fluxes in 1e-19
# erg/s/cm^2.
mag_flux = mag

# Type of magnitude/flux: petro, auto, aper_3, aper_6, iso. All types
# included in the obs_data file will be presented in terminal after
# -check procedure. If the data_type selected is not presented in the
# file, an error will be displayed.
data_type = aper_6

# Set of line emissions to be analyzed. Options are:
# Halpha+NII , Hbeta+OIII , Hbeta , [OIII], [OII]
lines = Halpha+NII

# Narrow band where the line emission is located. Options are: J0378,
# J0395, J0410, J0430, J0515, J0660, J0861
bandExcess = J0660
```

Results line emission flux and EW

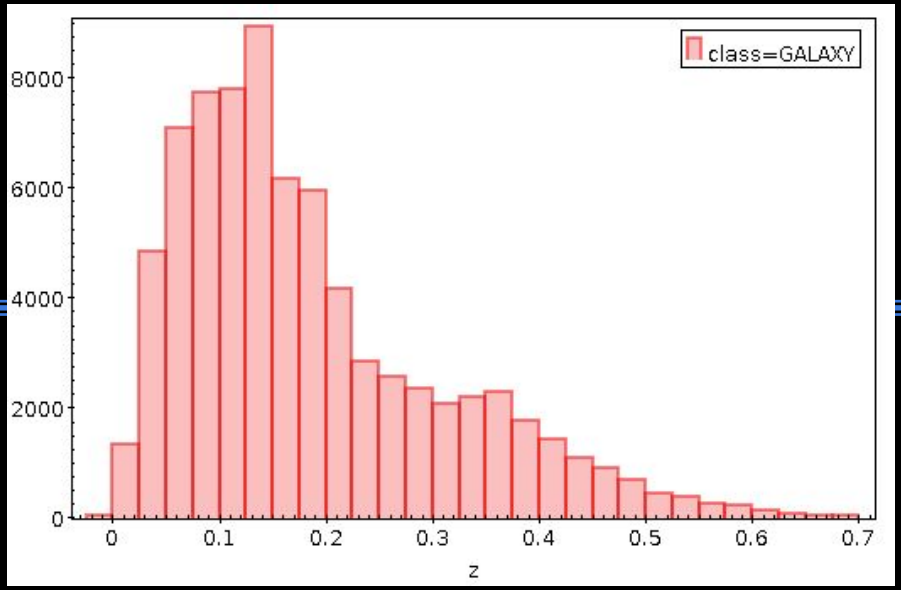




Testing selection

Cross-match between SDSS DR16 e S-PLUS iDR3 (Stripe82) for all objects with spectroscopic measurements

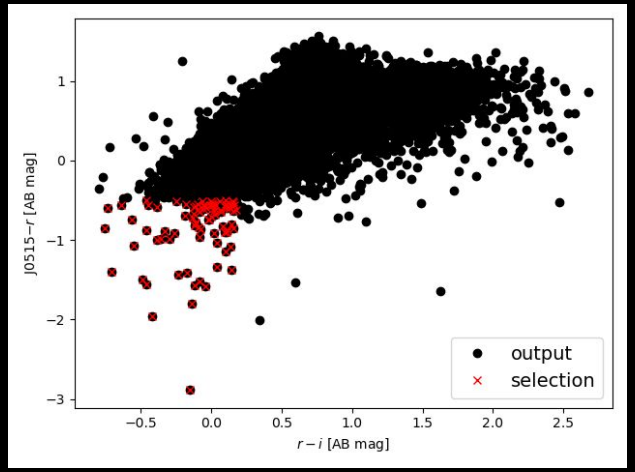
Total: 137084 objects
- \+ 75921 galaxies
- \+ 58945 stars
- \+ 2218 QSOs

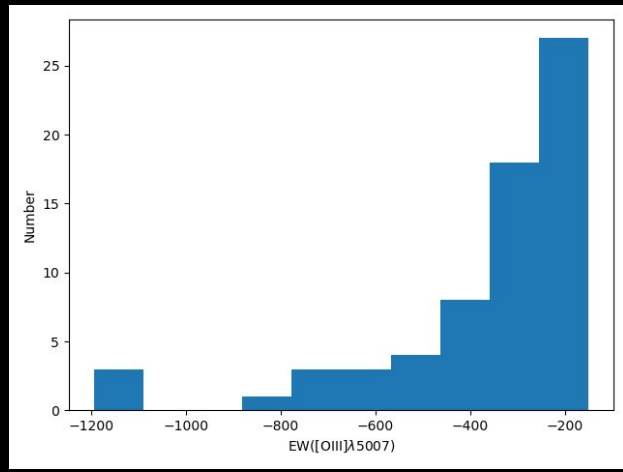


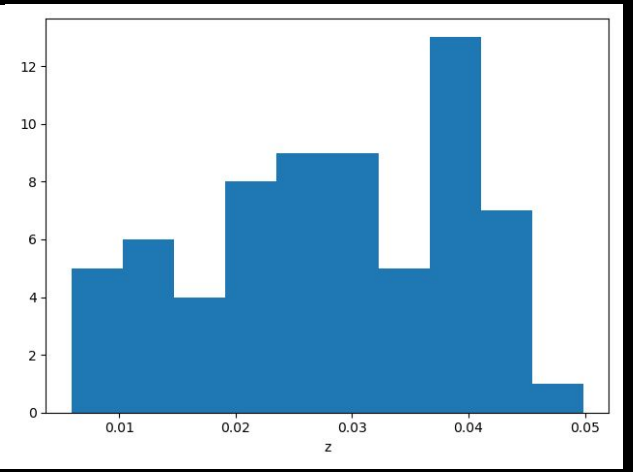
Testing selection

Searching for strong [OIII] emitters at 0.008<z<0.05
Input: 137084 => Output: 78325
After color-color selection: 68 objects

Galaxies: 67
Stars: 1
QSOs: 0



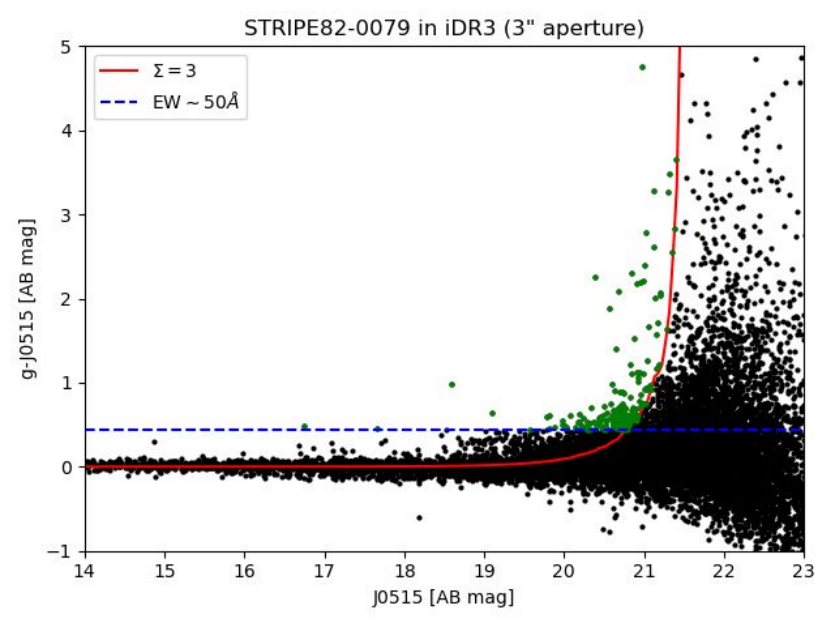




This selection loses 5 galaxies with EW([OIII]5007)>200A in 0.008<z<0.05

Candidate EELG selection in Stripe82

Searching for strong [OIII] emitters at 0.008<z<0.05 in 170 Stripe82 fields in S-PLUS

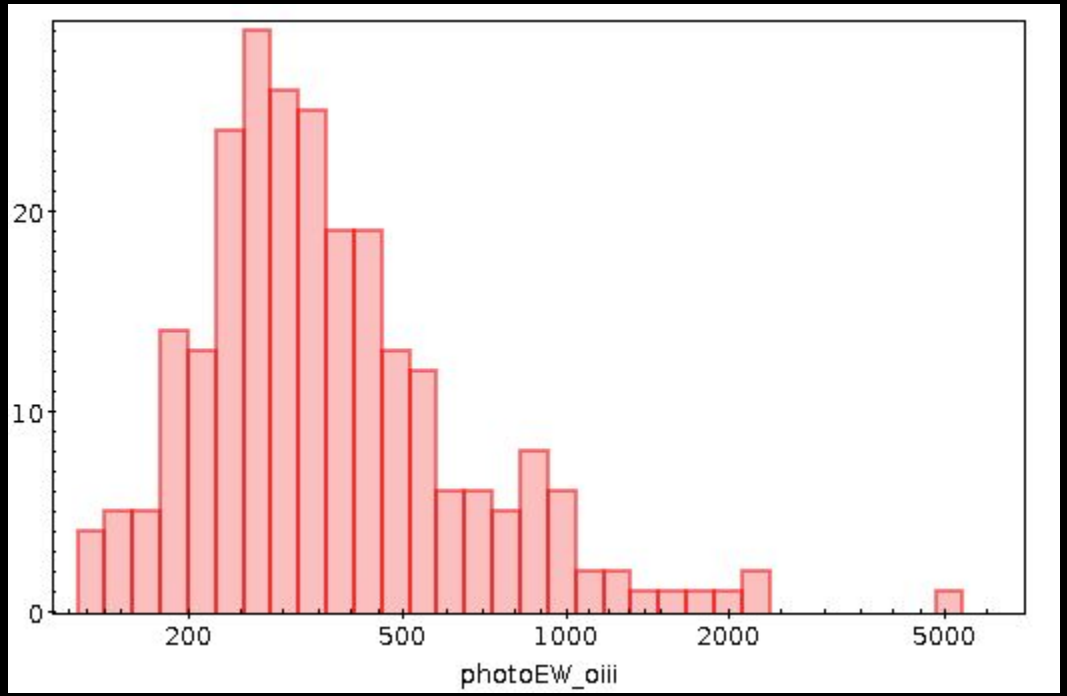


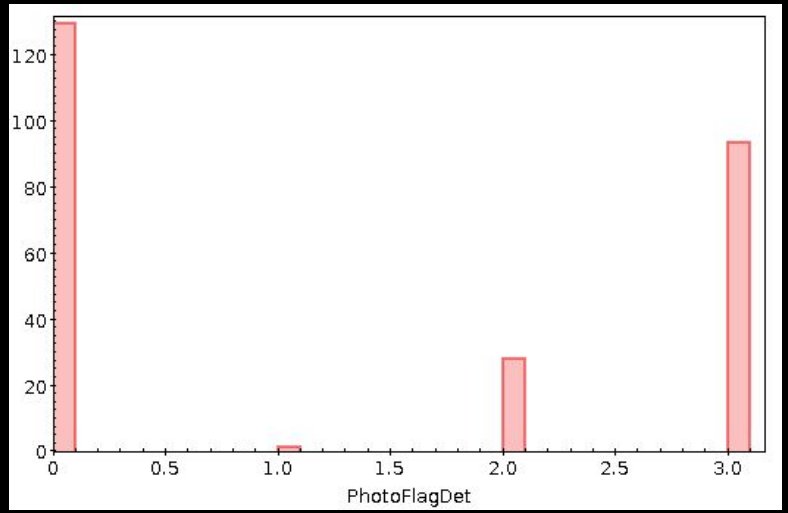
Color significance cut (> 3σ):

$$\Sigma = 1 - \frac{10^{-0.4(g - J0515)}}{10^{-0.4(z_p - J0515)} \sqrt{\sigma_g^2 + \sigma_{J0515}^2}}$$

Candidate EELG selection in Stripe82

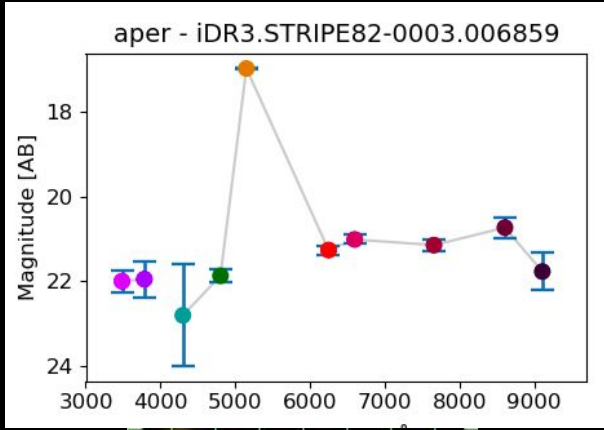
For 163 fields : 251 objects (mag err<0.1)

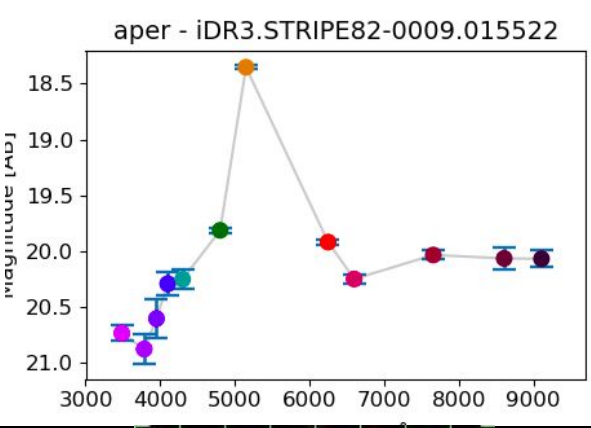


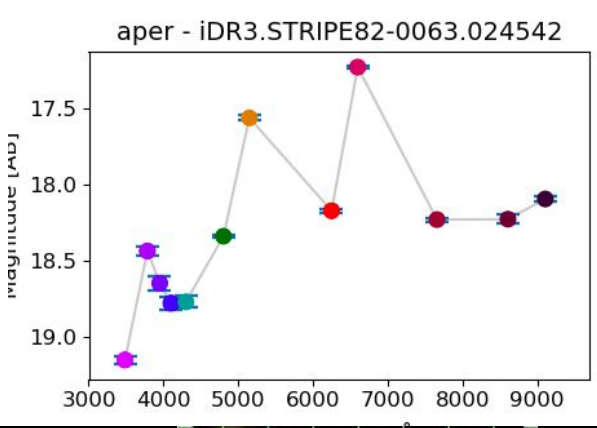


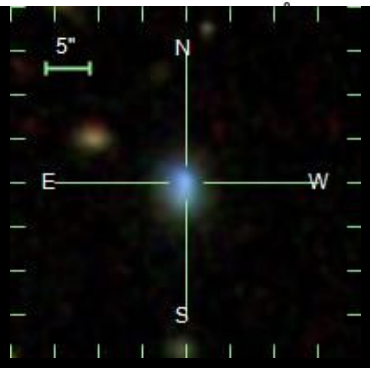
Candidate EELG selection in Stripe82

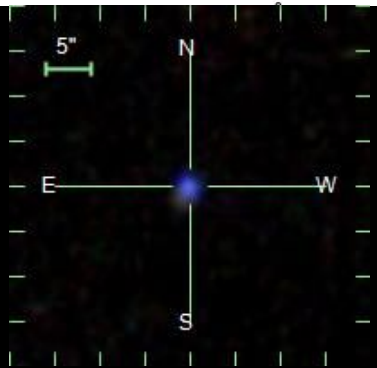
Some known objects:

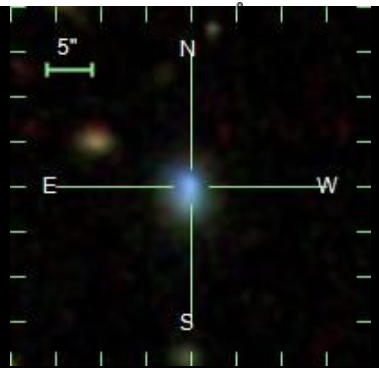












Conclusions and perspectives

- The search for extreme [OIII] emitters is promising
- We still need to correct for potential high-z interlopers
- Finalize the 170 Stripe82 fields
- Characterize the candidates (mass, SFR, stellar populations,...)
- Spectroscopic follow-up for best candidates
- Search for [OIII] emitters at J0660 and Hα at J0660 and J0861

- Any comments, suggestions or questions:

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