Emission Line Galaxies in the CANDELS fields

ELG Equivalent Width distributions using Broadband Photometry at z<2

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1. CONTEXT

Detailed study of star formation from emission nebulae is inaccessible at high-redshifts. However, up to the z=2 peak of cosmic star formation a rising number of young dwarf galaxies are dominated by nebular emission. This enables an indirect study of high-z star formation through optical emission lines [OII], [OIII] and Hα.

This approach relies exclusively on deep broadband photometry over the wide visible-IR wavelength coverage provided by CANDELS to deliver emission line EWs. We use an auxiliary set of line-free BC03 models with stochastic SFHs to aid the broadbands by estimating a line-free continuum while only having to fit for redshifts. This method can complement existing spectroscopic and narrowband efforts to understand the demographics of star forming galaxies across redshift and mass.

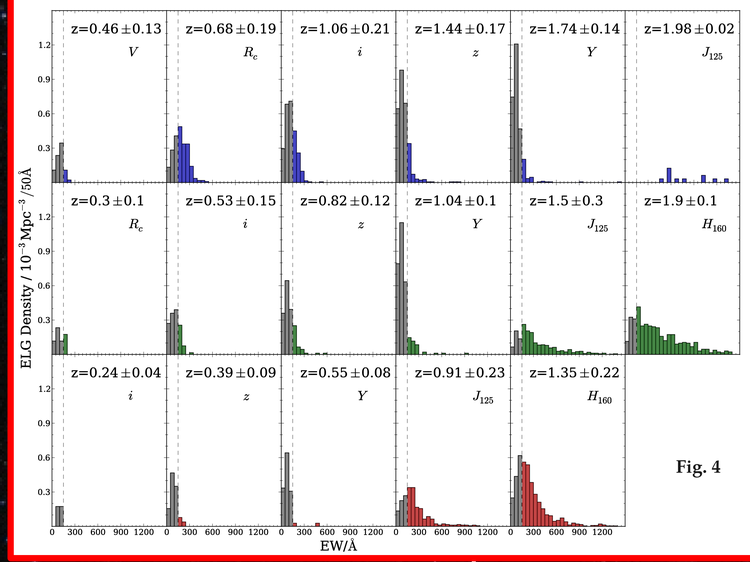

Fig. 4

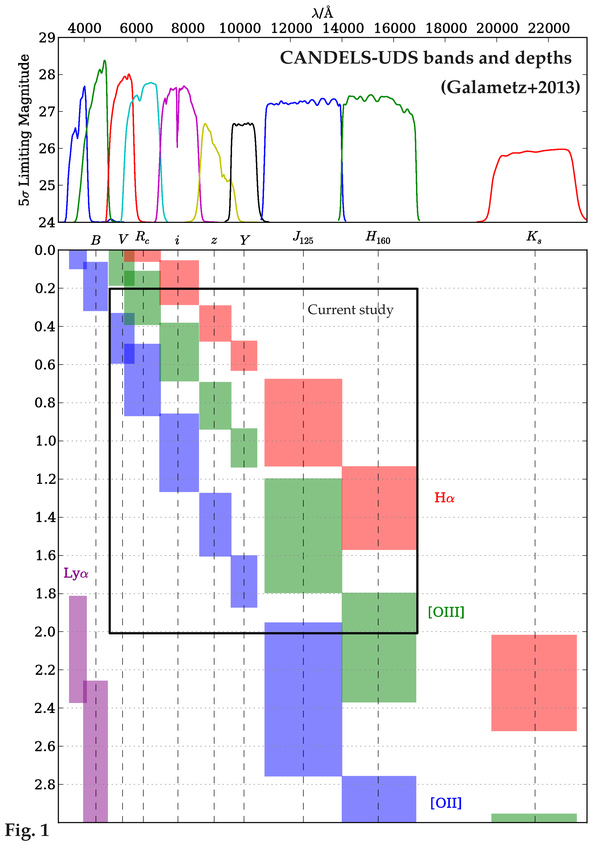

Fig. 1

2. METHOD & COLOUR SETUP

Blue and red line-free filters are chosen (at 0.2<z<2 B and K, z>2 will require IRAC bands) to make (B-K,X-K) colour coordinates, with X any filter between B and K. Departures from the expected line-free colours in a redshift window indicate the presence of an emission line (Fig. 2).

The ELGs identified have B-K<2 , indicating a weak balmer break, so these galaxies are very young, dominated by a very recent star formation episode and have had time to form little dust (Av<0.5).

Fig. 1 shows the expected contaminated redshift windows, reproduced in the same colour scheme in all figures. Fig 3. shows that despite scatter in photometry, photo-zs and model uncertainties, emission lines can be clearly identified in the expected windows.

Offsets in the contaminated redshift windows are converted into restframe equivalent widths (EWs) through:

$$EW_{restframe} = \frac{10^{\frac{-\Delta X}{-2.5}} - 1}{1+z} W$$

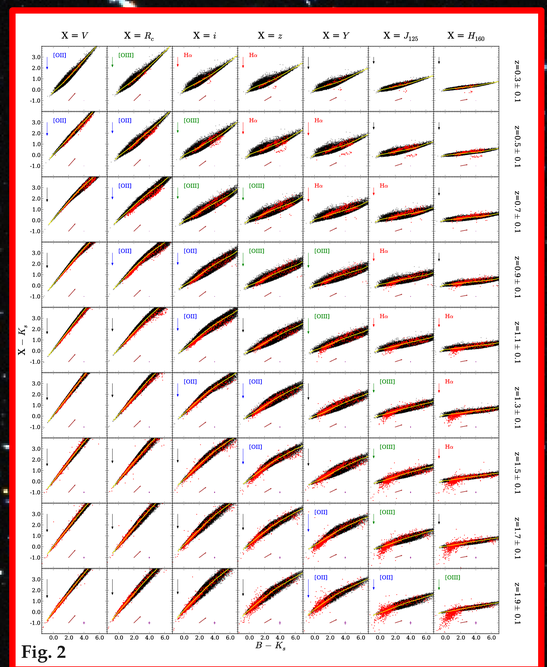

Fig. 2

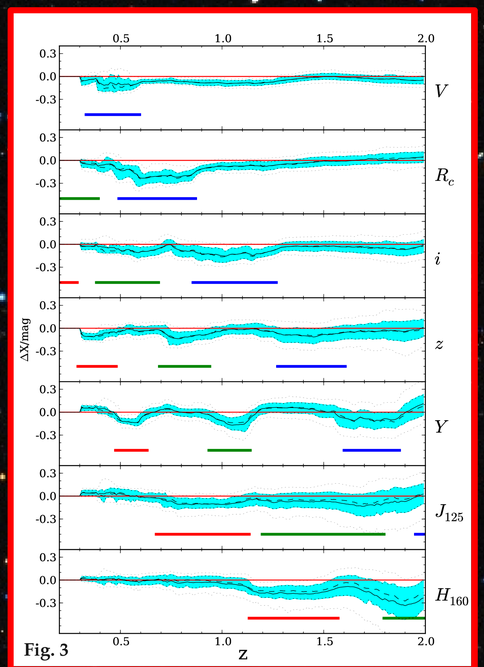

Fig. 3

3. EW DISTRIBUTIONS and ELG FRACTIONS

Fig. 4 shows the EW distributions obtained for each of the redshift windows shown in Fig. 1 for H<26 and log10(M/Msun)>9. While [OII] shows almost only EWs<300A, Hα and [OIII] display very high equivalent widths with increasing redshift.

Finally, the ratio between objects selected in each window of Fig. 4 and all objects of any colour (Fig. 2) present in that window (Fig. 1) is shown across redshift. Wide windows were divided into two to improve sampling.

Naturally Hα increases: it is an indicator of star formation. [OIII] also increases but seems to peak earlier, whereas [OII] either peaks later or at best stays flat. This is further evidence that the ionization parameter for the radiation field in these galaxies (proportional to O[III]/[OII]) decreases with redshift.

To further confirm this, the method will be applied to all other CANDELS fields (for better statistics and eventual filter dithering) and extended to z>2 in order to conclude on how the increase in ELG fraction impacts the highest-z galaxies. Does it saturate at low masses, how quickly does it move up in mass with z or does it peak like star formation?

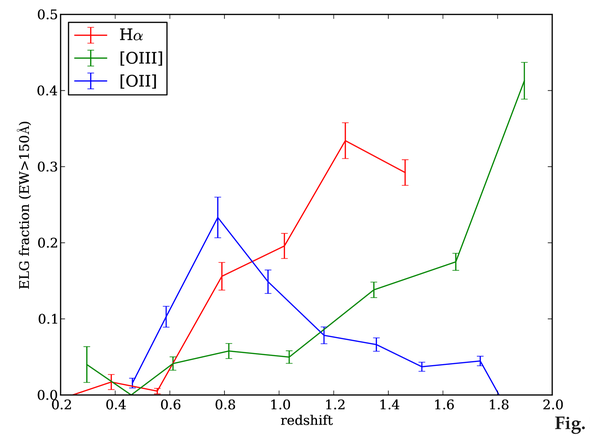

Fig. 5

REFERENCES

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Dahlen+2013, Smit+ 2014, Sobral+ 2014, 2015 , Huang+2015, Morris+ 2015, Khostovan+ 2015

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