Abundance and clustering of Hα emitters in Euclid

SYLVAIN DE LA TORRE

AND SHUN SAITO, OLIVIER ILBERT

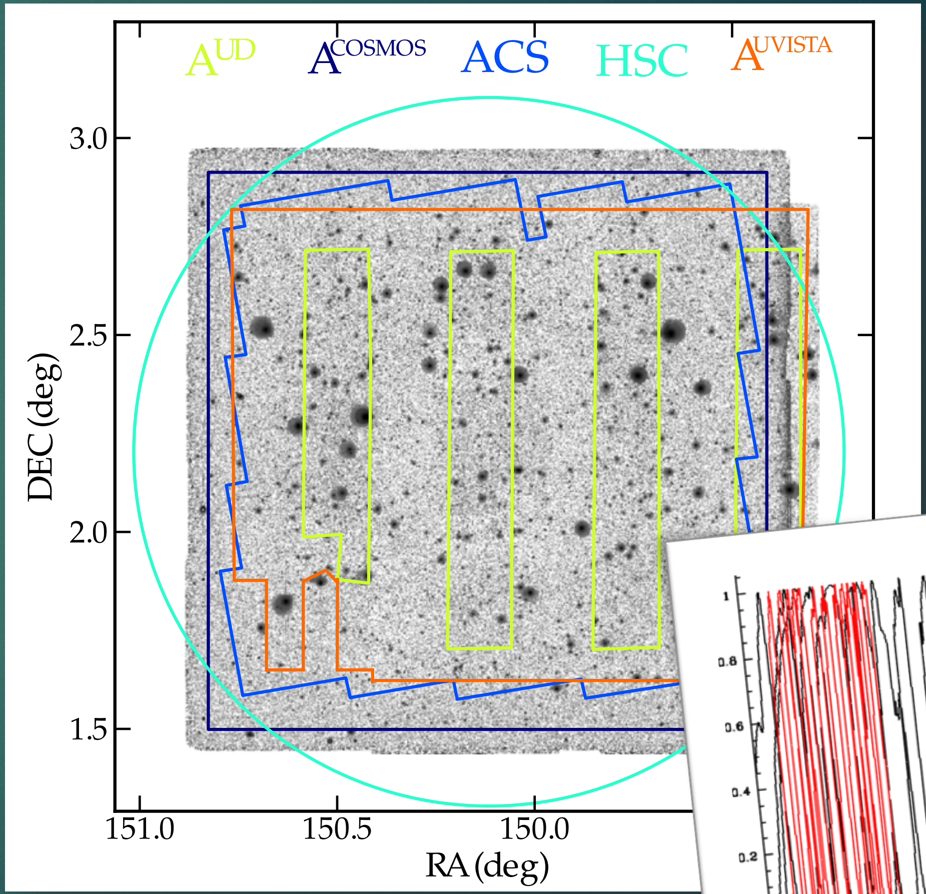
Outline

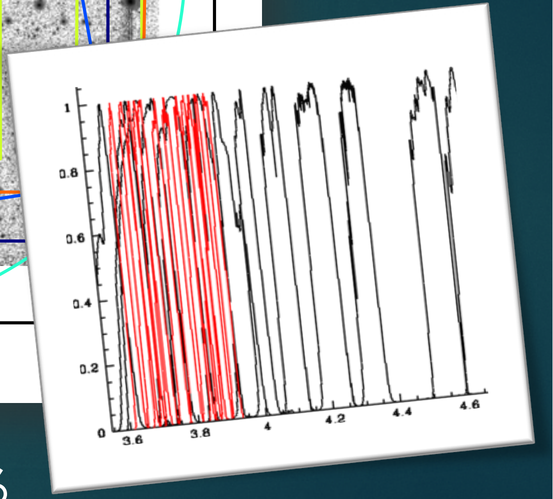
- The COSMOS 2015 catalogue
- Modelling galaxy SED and emission-line fluxes
- H_{α} and [OII] luminosity function
- Clustering and HOD modelling of H_{α} emitters
- Summary

COSMOS field

- COSMOS 2015 (Laigle et al. 2016)
  - 2 deg2
  - About 1 million sources detected in zYJHK as deep as 26.5 in i+ band
  - Multi-color coverage from UV to far-IR
  - Medium bands in visible
  - Photometric redshift with 0.01(1+z) accuracy at i<22.5

COSMOS field layout





Laigle et al. 2016

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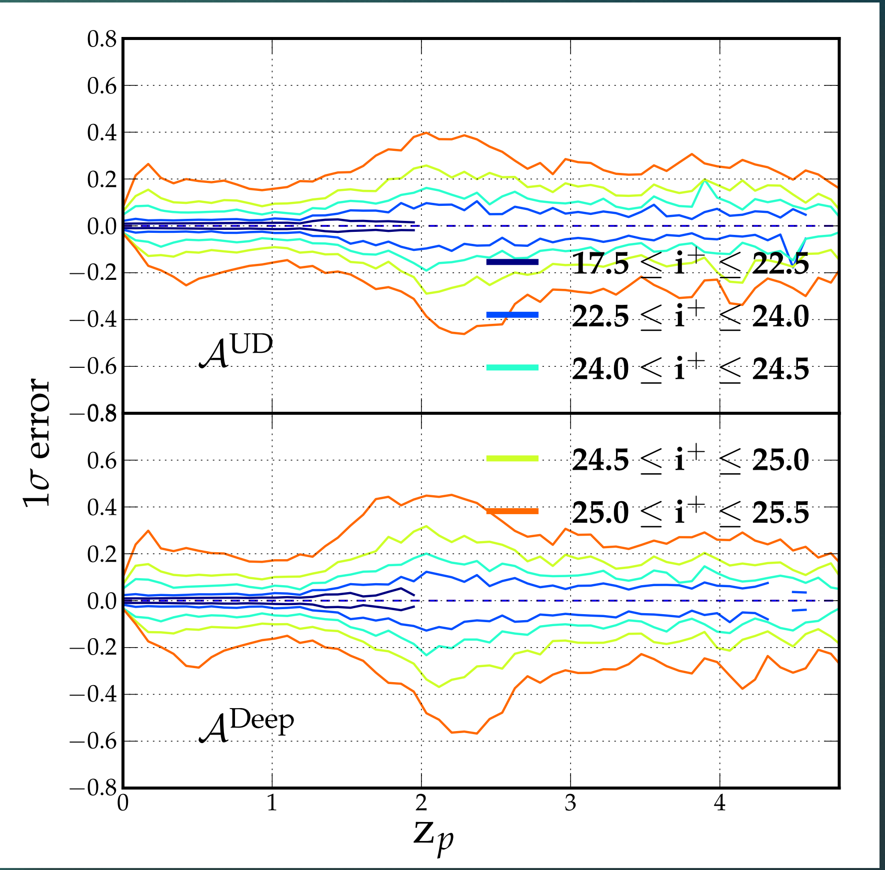
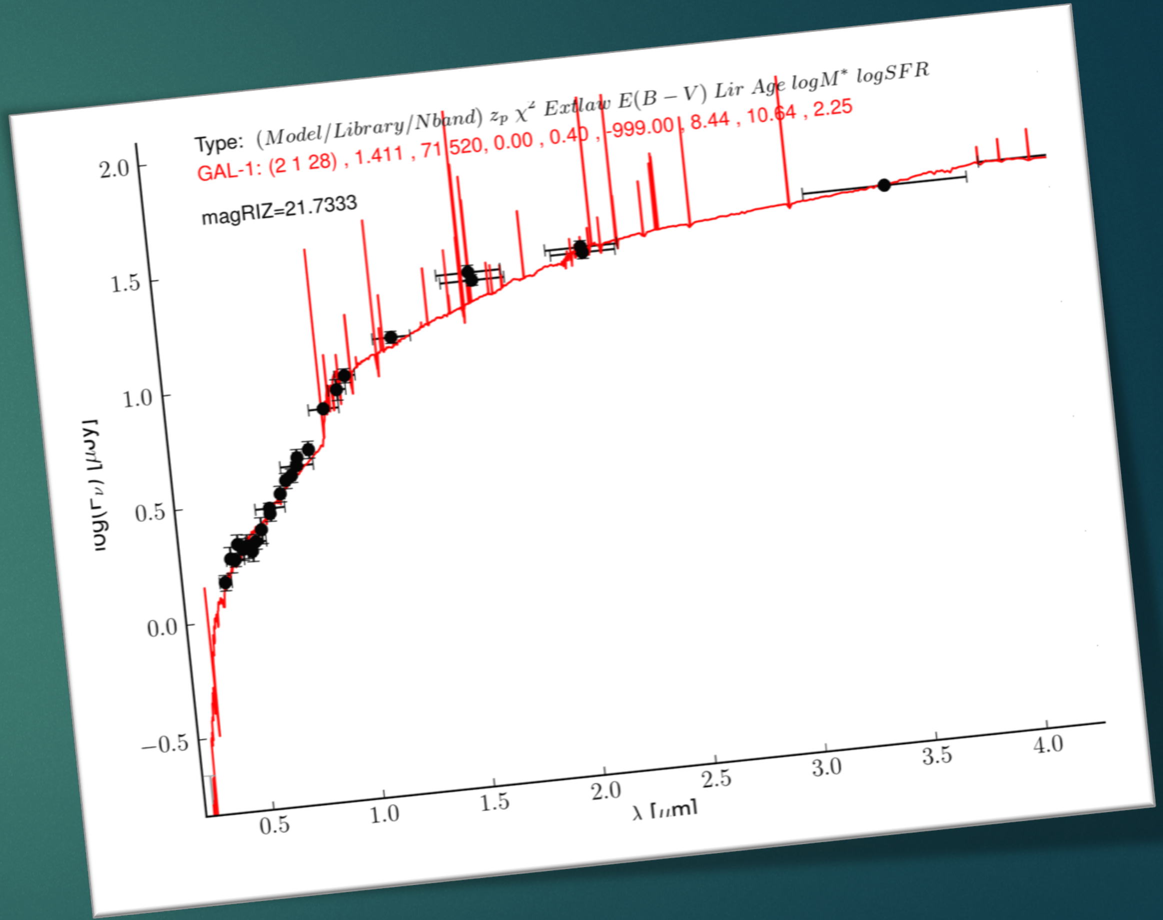
Photo-z accuracy



Laigle et al. 2016

SED & Emission lines modelling

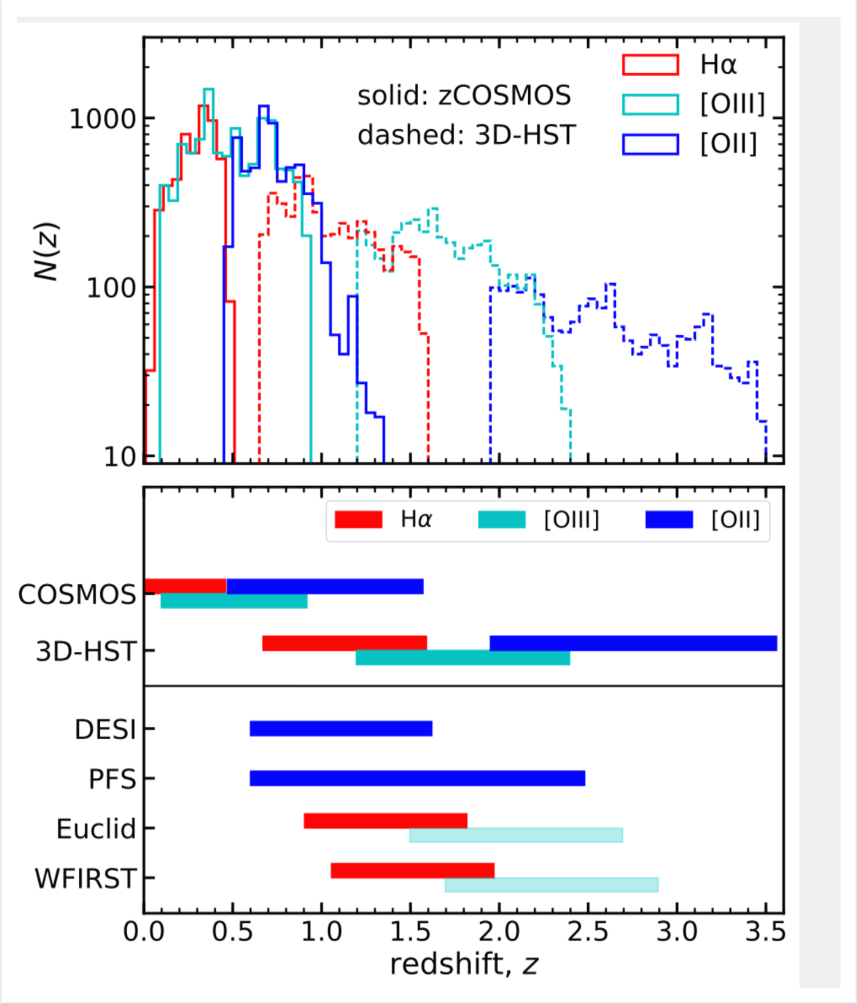
- Stellar continuum
  - Bruzual & Charlot '03 templates
  - Two SFHs: exponentially declining or delayed
  - Dust extinction: Arnouts+ '13 and Calzetti+ '00
- Continuum and EL emission from star-forming regions (Shaerer & de Barros '09)
  - Use number Lyman continuum photons
  - Lines- ratios for other EL tabulated (3 metallicities)
  - Differential extinction between continuum and nebular regions, need data calibration



Use of ***LePhare*** code (Arnouts et al., Ilbert et al.)

Calibration of the method

- Need to calibrate the method, particularly nebular extinction
- Use of reference samples of measured emission lines: zCOSMOS & 3D-HST



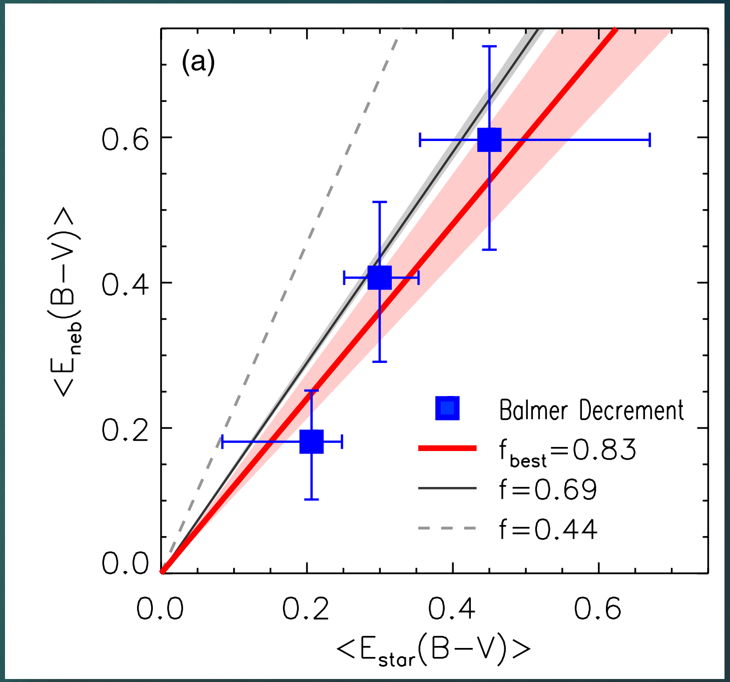
Saito, de la Torre, Ilbert et al., in prep.

Calibration of the method

- Calibration of nebular to stellar extinction ratio f:

$$E_{\rm neb}(B-V) = \frac{E_{\rm star}(B-V)}{f}$$

- Redshift dependence of f: less nebular attenuation wrt stellar at high redshift (e.g. Erb et al. ‘06, Reddy et al. ‘10, Kashino et al. ‘13, Price et la. ‘14, Panella et al. ‘15)



Kashino et al. 2013

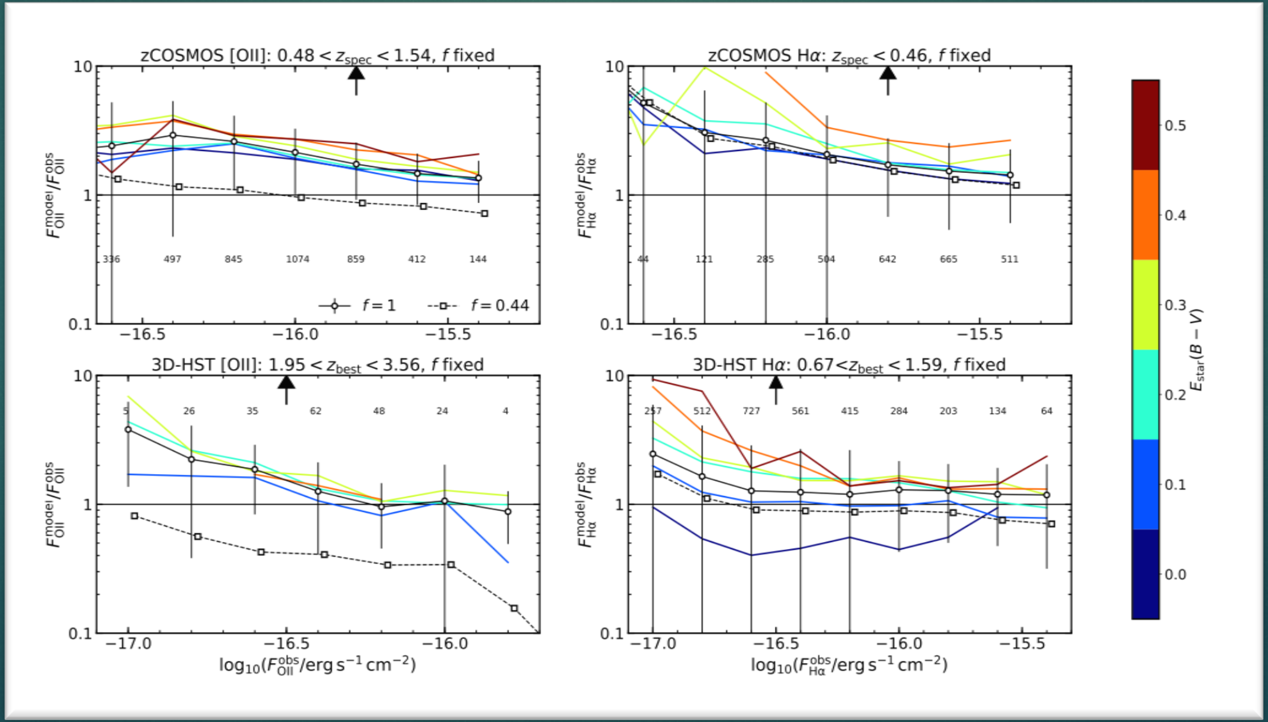
Saito, de la Torre, Ilbert et al., in prep.

Calibration of the method

- Calibration of nebular to stellar extinction ratio f:

$$E_{\mathrm{neb}}(B-V) = \frac{E_{\mathrm{star}}(B-V)}{f}$$

- Recovery of measured EL fluxes in 3DHST and zCOSMOS



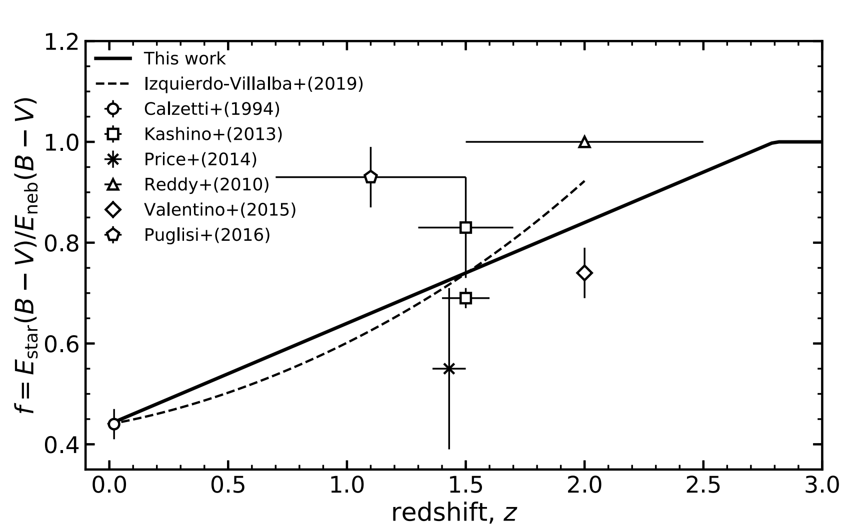
Calibration of the method

- Calibration of nebular to stellar extinction ratio f:

$$E_{\rm neb}(B-V) = \frac{E_{\rm star}(B-V)}{f}$$

- Use the redshift dependent nebular to stellar extinction ratio that best allows recovering observed fluxes in the reference samples:

$$f(z) = 0.44 + 0.2z$$



Saito, de la Torre, Ilbert et al., in prep.

COSMOS emission lines catalogue

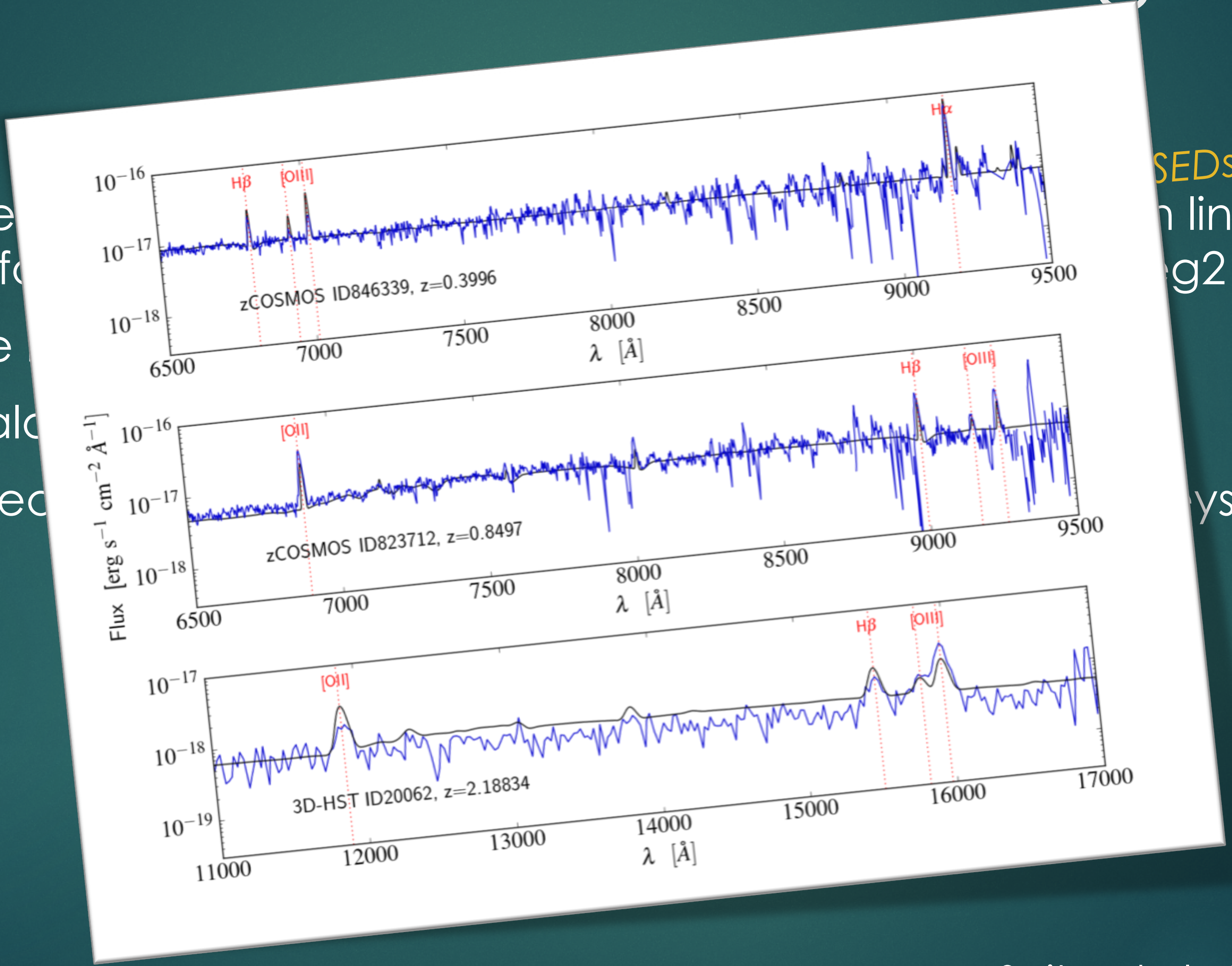
- A value-added COSMOS catalogue with predicted emission line fluxes (for main ELs) for more than 500 000 galaxies over 2 deg^2
- Provide model SED for each galaxy (including ELs)
- EL catalogue & SEDs will be made public very soon
- Designed to prepare next-generation large (bright) ELG surveys

Saito, de la Torre, Ilbert et al., in prep.

COSMOS emission lines catalogue

- A value... fluxes (fo... ...n line ...g2
- Provide ...
- EL catalo...
- Designed ... ...ys

SEDs



Saito, de la Torre, Ilbert et al., in prep.

COSMOS emission lines catalogue

- A v… flux…
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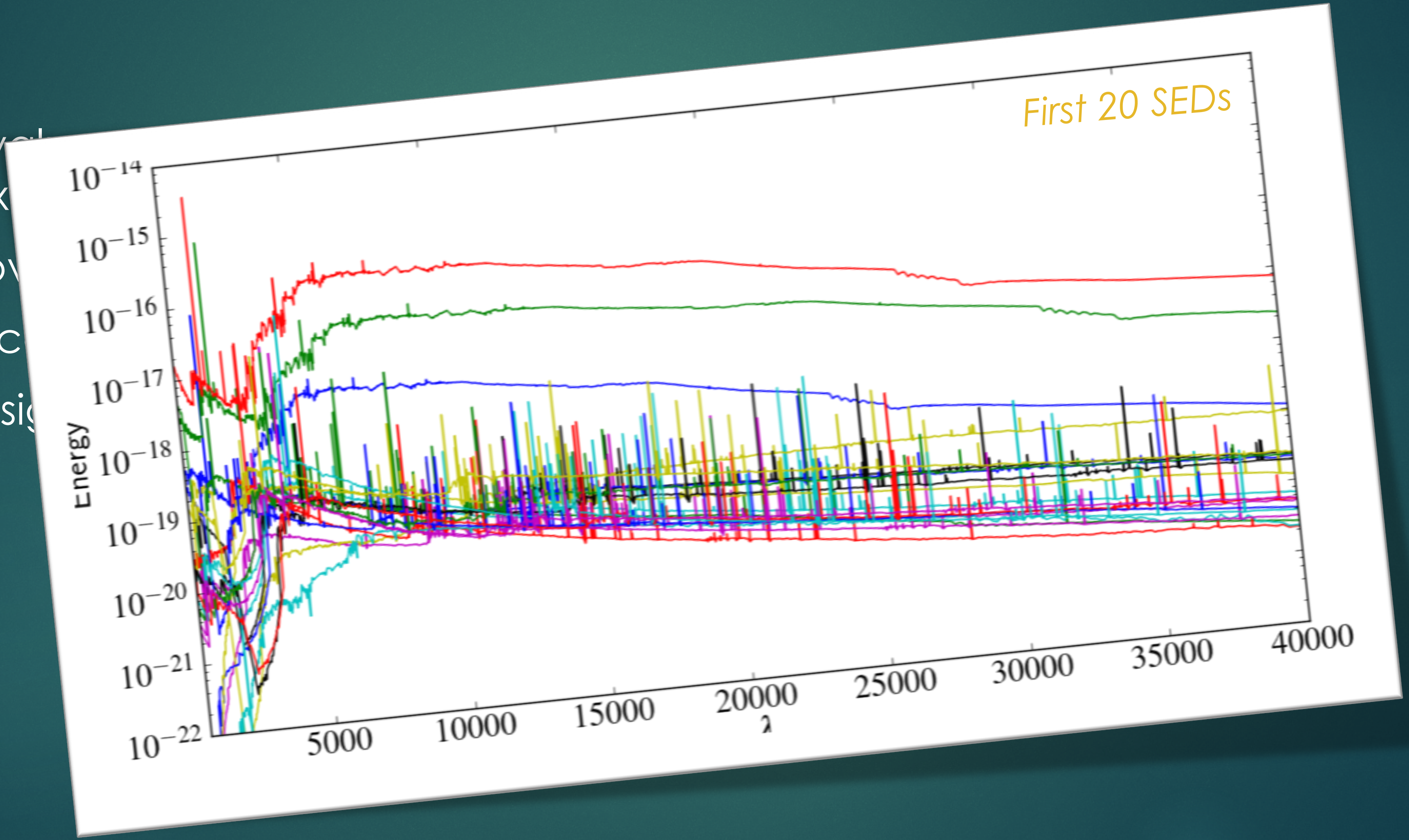
- Desi…

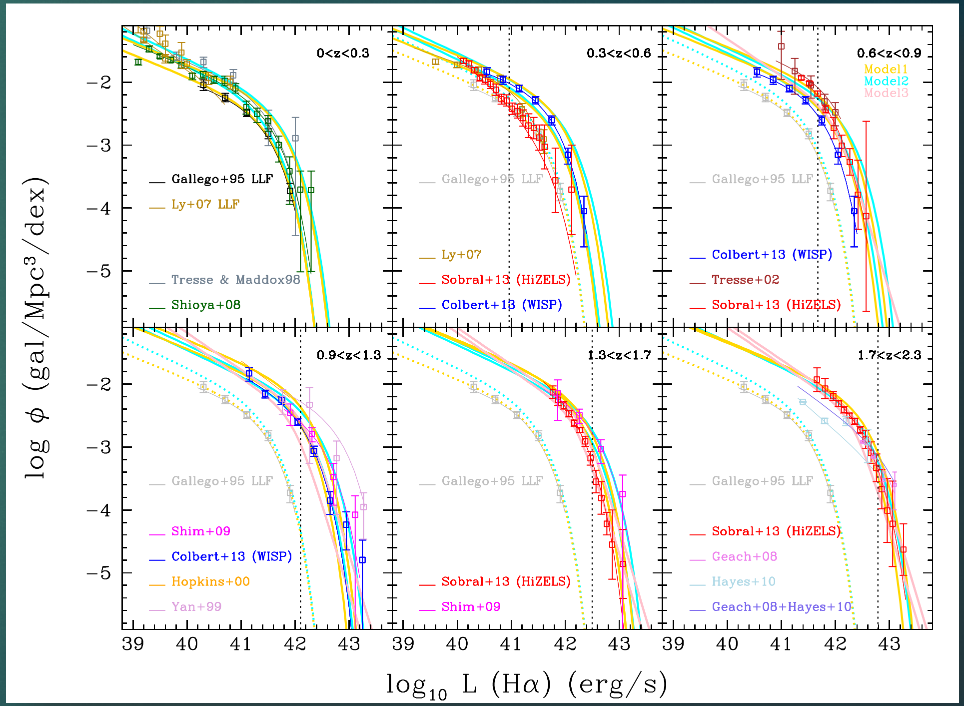


Saito, de la Torre, Ilbert et al., in prep.

H_α luminosity function

- Current LF measurements are uncertain, particularly at z>1
- But crucial for preparing next-generation cosmological surveys (Euclid, DESI, PFS, WFIRST…)
- Currently, small fields dominated by sample variance at high redshift (areas<0.2 deg²)

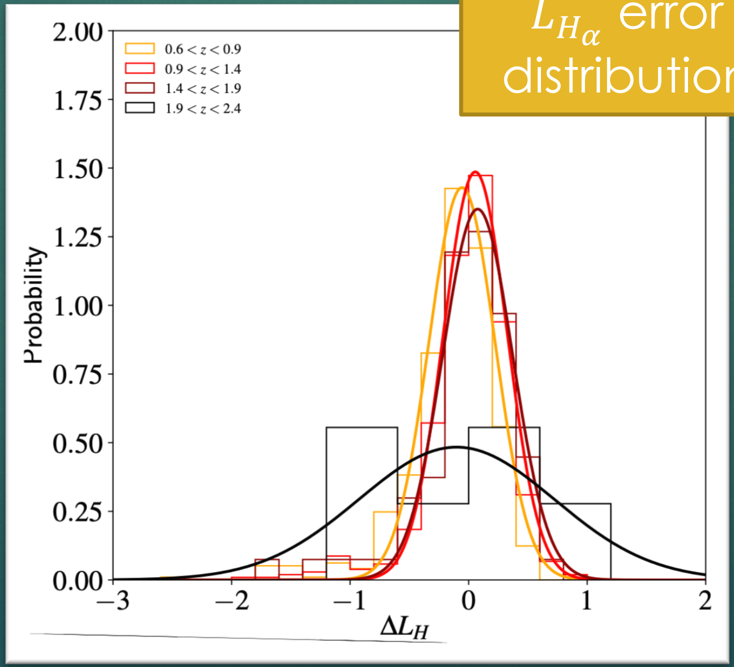
Compilation of measured H_α LFs



Pozzetti et al., 2016

H_α luminosity function

- Use predicted flux from SED modelling of COSMOS galaxies
- Measure the luminosity function in redshift bins
- Forward modelling of the effect of luminosity error: $\phi^m(L) = \widetilde{\phi^m}(L) \otimes \epsilon(L)$

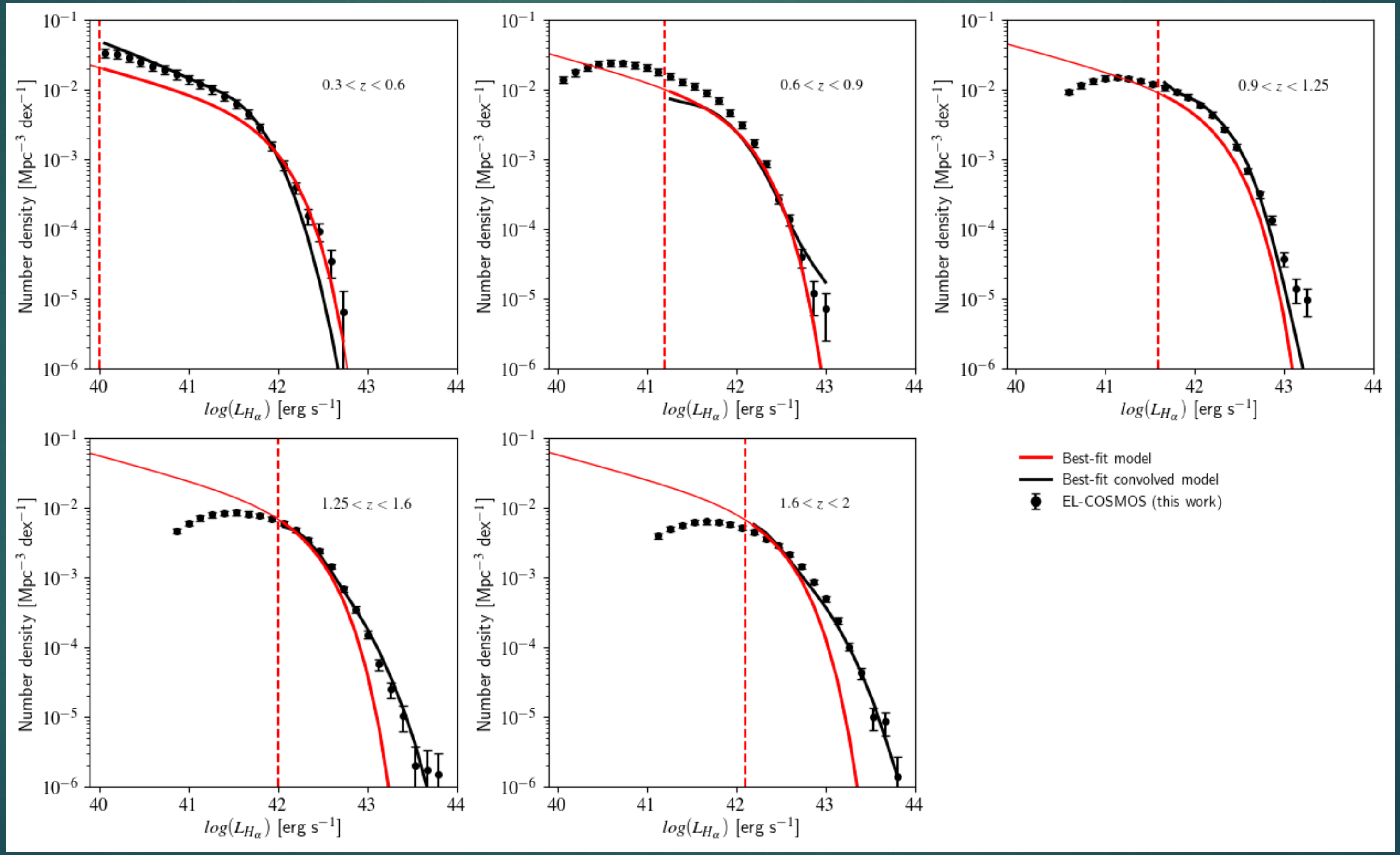


L_{H_α} error distribution

Saito, de la Torre, Ilbert et al., in prep.

H_α luminosity function

- H_α luminosity functions



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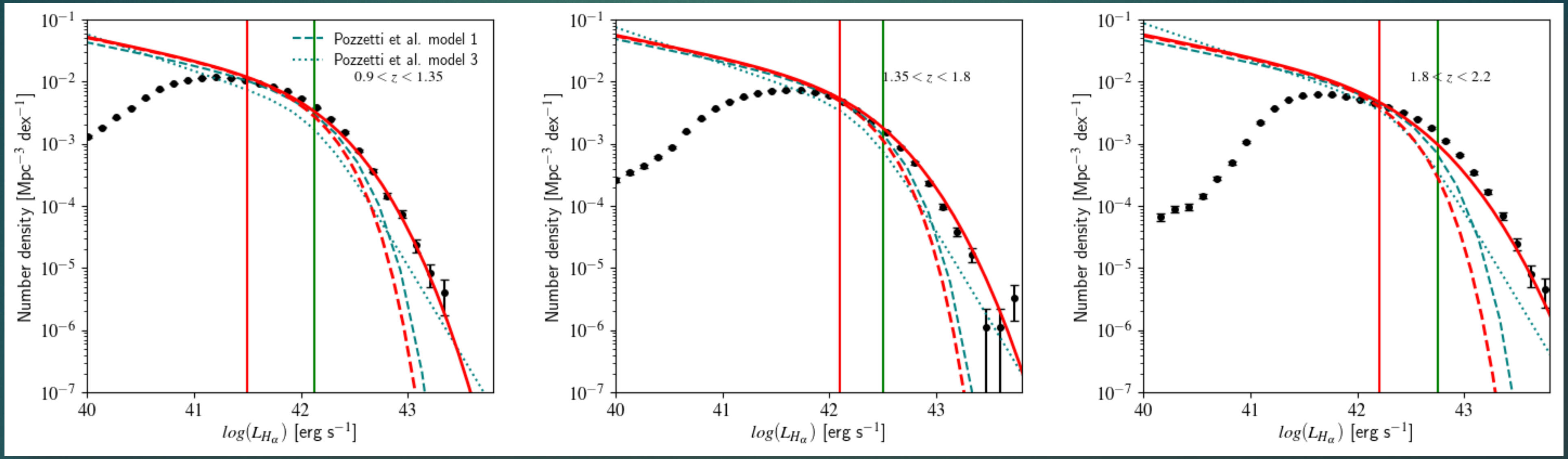
H_α luminosity function

- H_α luminosity functions

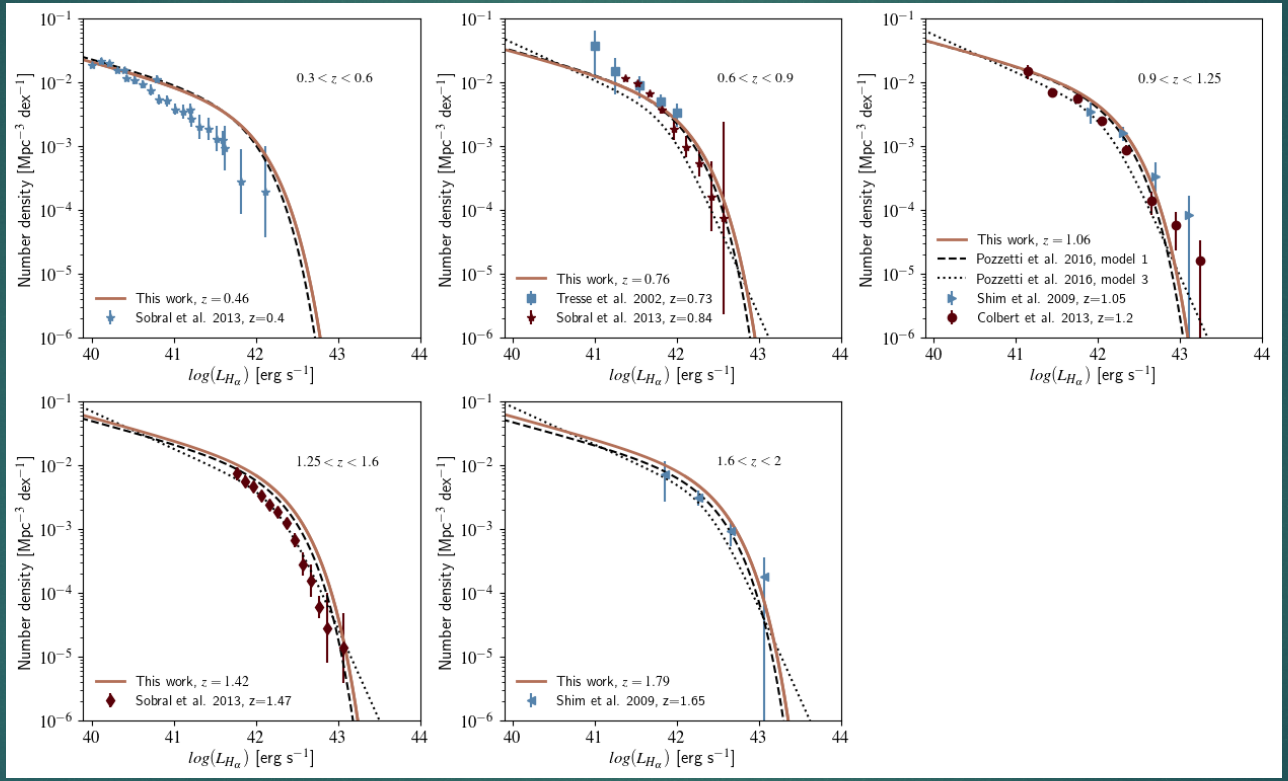


- Assumed H_α LF evolution (Geach+ '10):

$$L_{\star,z} = L_{\star,0}(1+z)^{\delta} \quad \Bigg| \quad \phi_{\star,z} = \begin{cases} \phi_{\star,0}(1+z)^{\epsilon} & z < z_{\text{break}} \\ \phi_{\star,0}(1+z_{\text{break}})^{2\epsilon}(1+z)^{-\epsilon} & z > z_{\text{break}} \end{cases}$$

H_α luminosity function

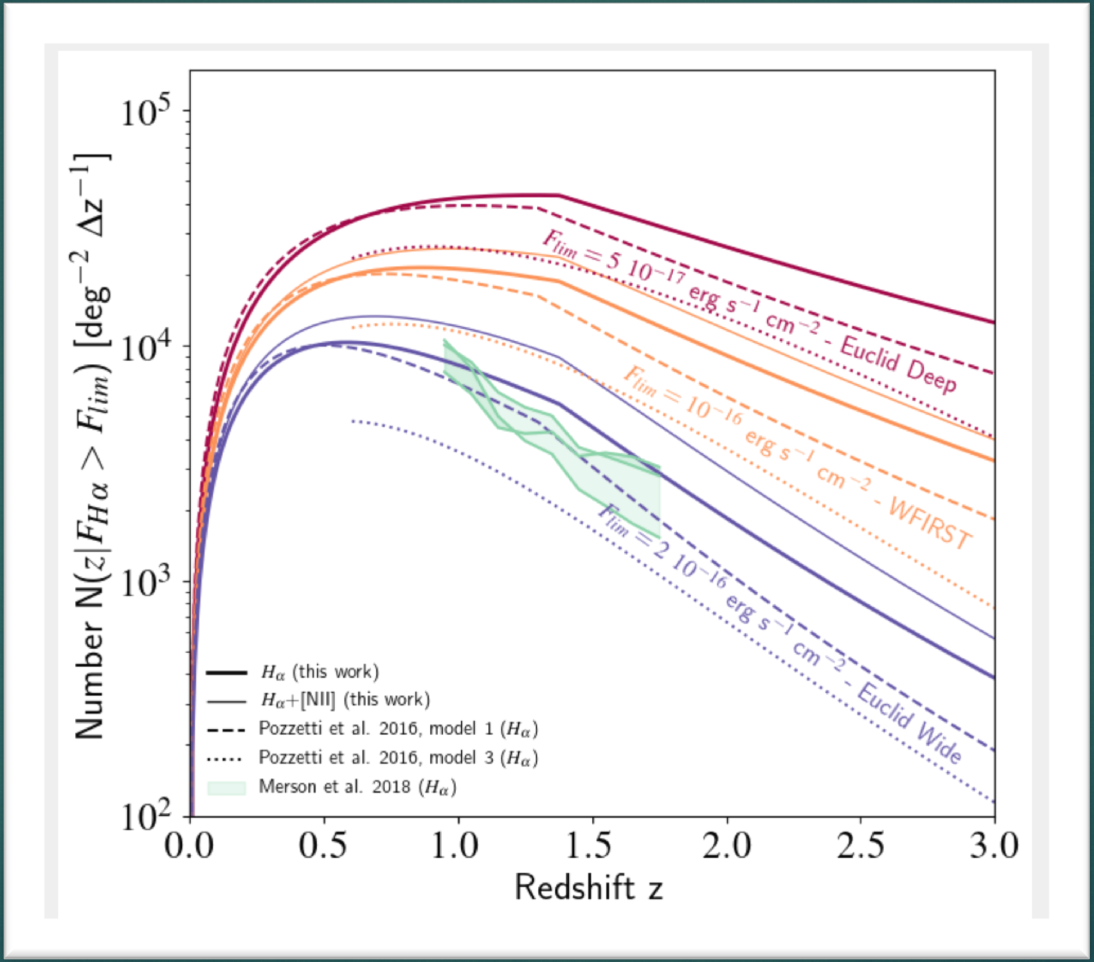
- H_α luminosity functions



- Good agreement with Pozzetti et al. '16 models (Euclid current baseline for cosmological forecasts)

Saito, de la Torre, Ilbert et al., in prep.

H_α galaxy counts



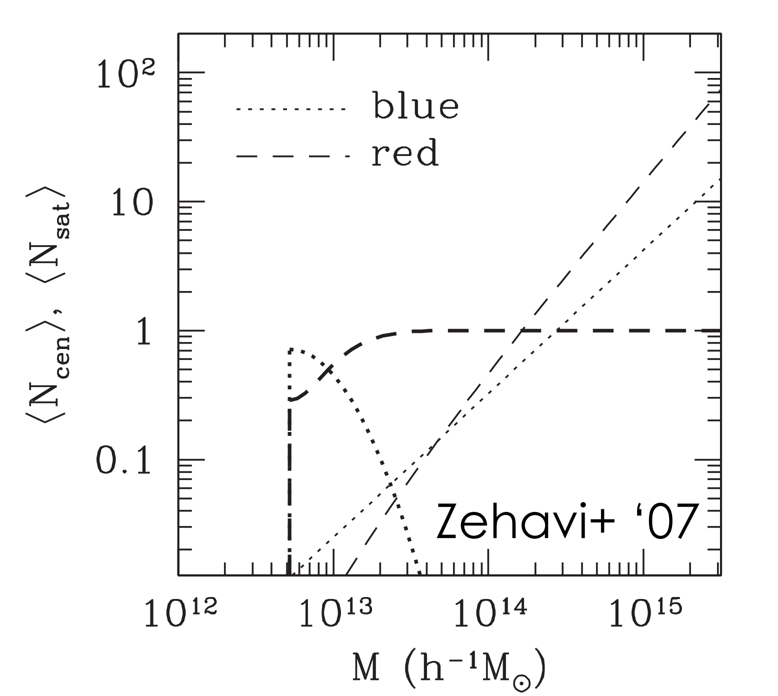
Saito, de la Torre, Ilbert et al., in prep.

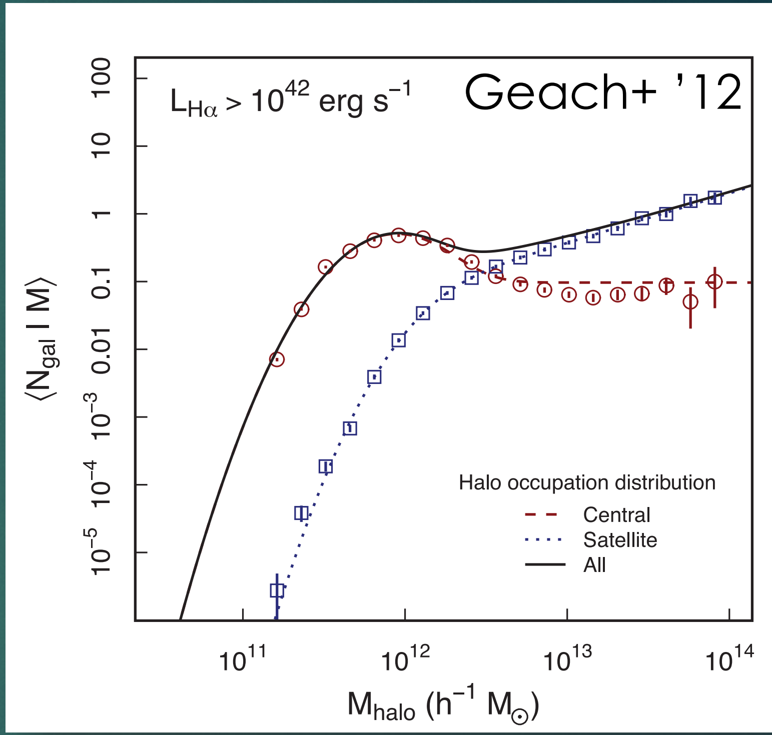
Clustering & halo modelling

- Clustering of ELG useful for:
  - Understanding the link between star formation in galaxies and assembly of the LSS
  - Preparing next-generation surveys, particularly for mock ELG galaxies
- COSMOS allows measuring angular clustering up to about z=2
  - Defined three redshift bins from z=0.9 to z=2.0
  - Clustering uncertainties estimated from HOD mocks based on BigMultidark following *de la Torre+13a,b*
  - Need to account for Integral constraint/volume effect, empirical correction based on mocks

Clustering & halo modelling

- Classical ELG HOD modelling (lum. threshold)





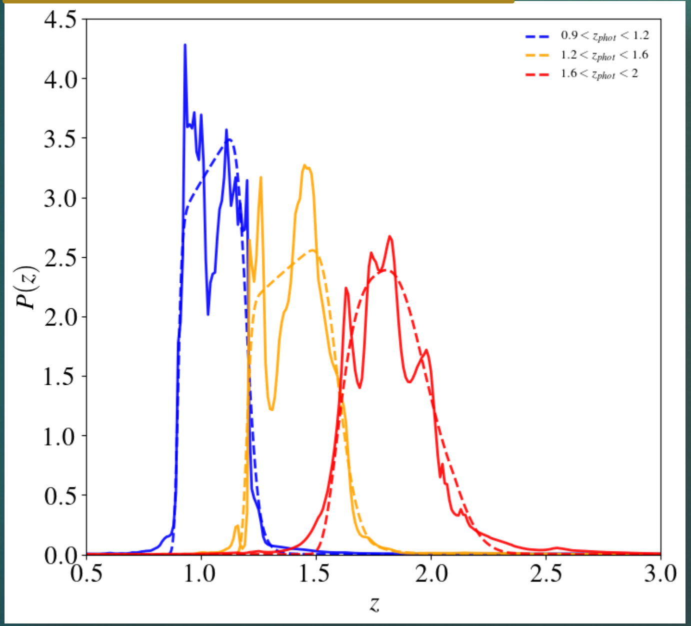
$$\langle N_c | M \rangle = F_c^B (1 - F_c^A) \exp\left[-\frac{\log(M/M_c)^2}{2\sigma_{\log M}^2} \right] + F_c^A \left[1 + \mathrm{erf}\left(\frac{\log(M/M_c)}{\sigma_{\log M}} \right) \right]$$

Clustering & halo modelling

Preliminary

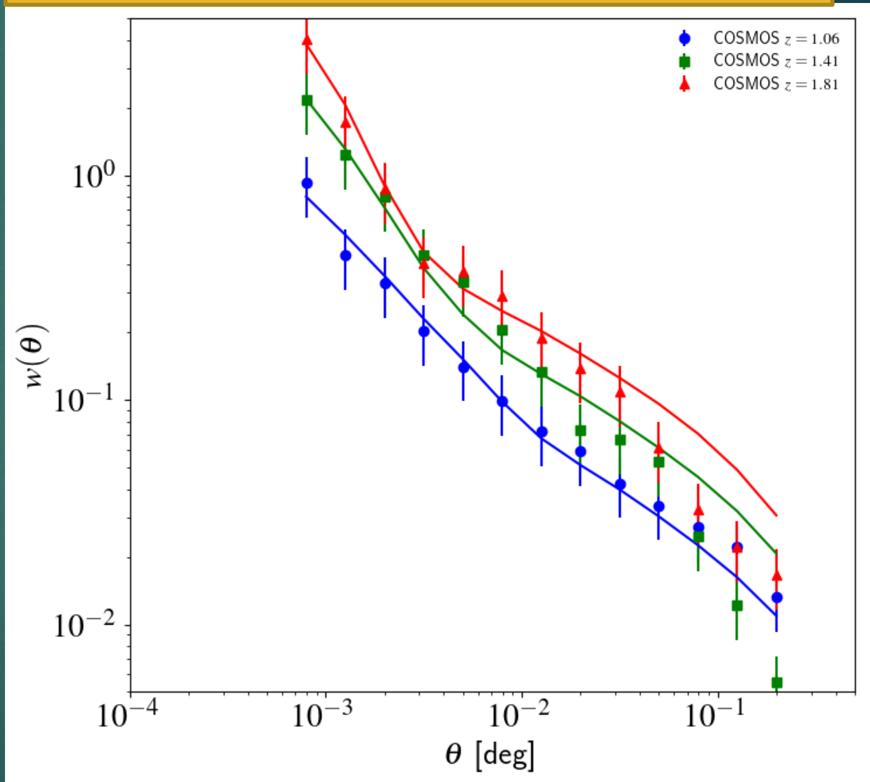
- HOD modelling in COSMOS

Redshift distributions



Based on photometric z-PDF

Best-fits for H_α luminosity thresholds

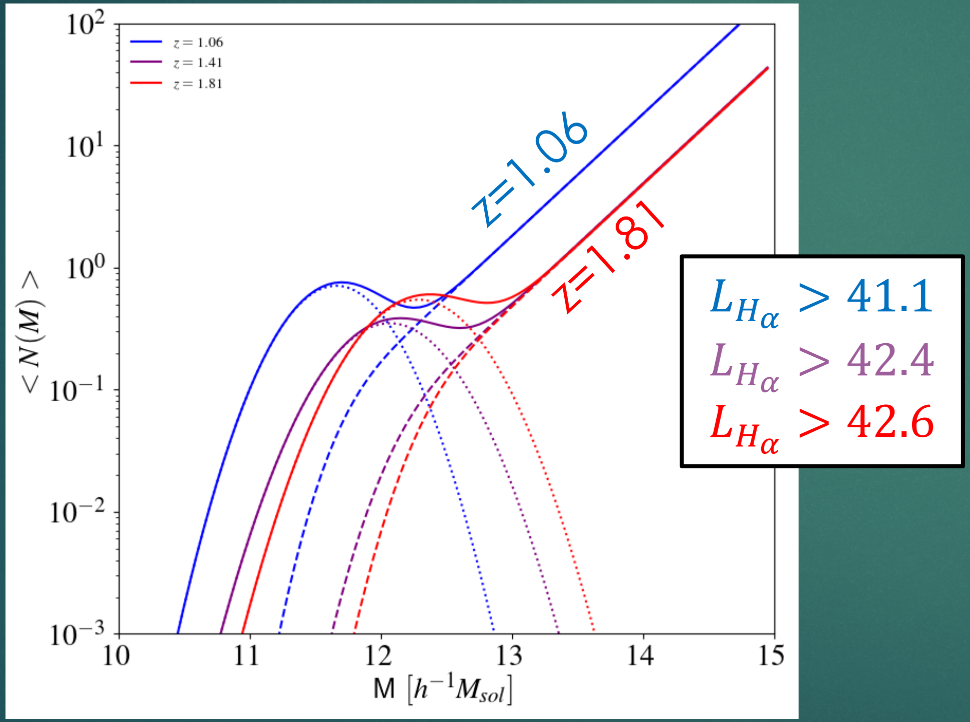


de la Torre et al., in prep.

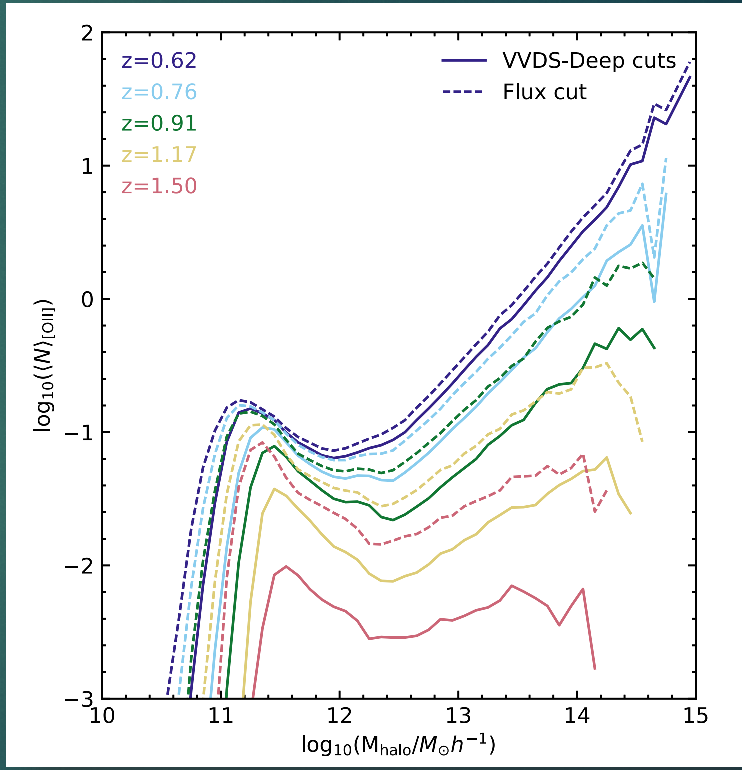
Clustering & halo modelling

Preliminary

- HOD modelling in COSMOS



de la Torre+, in prep.

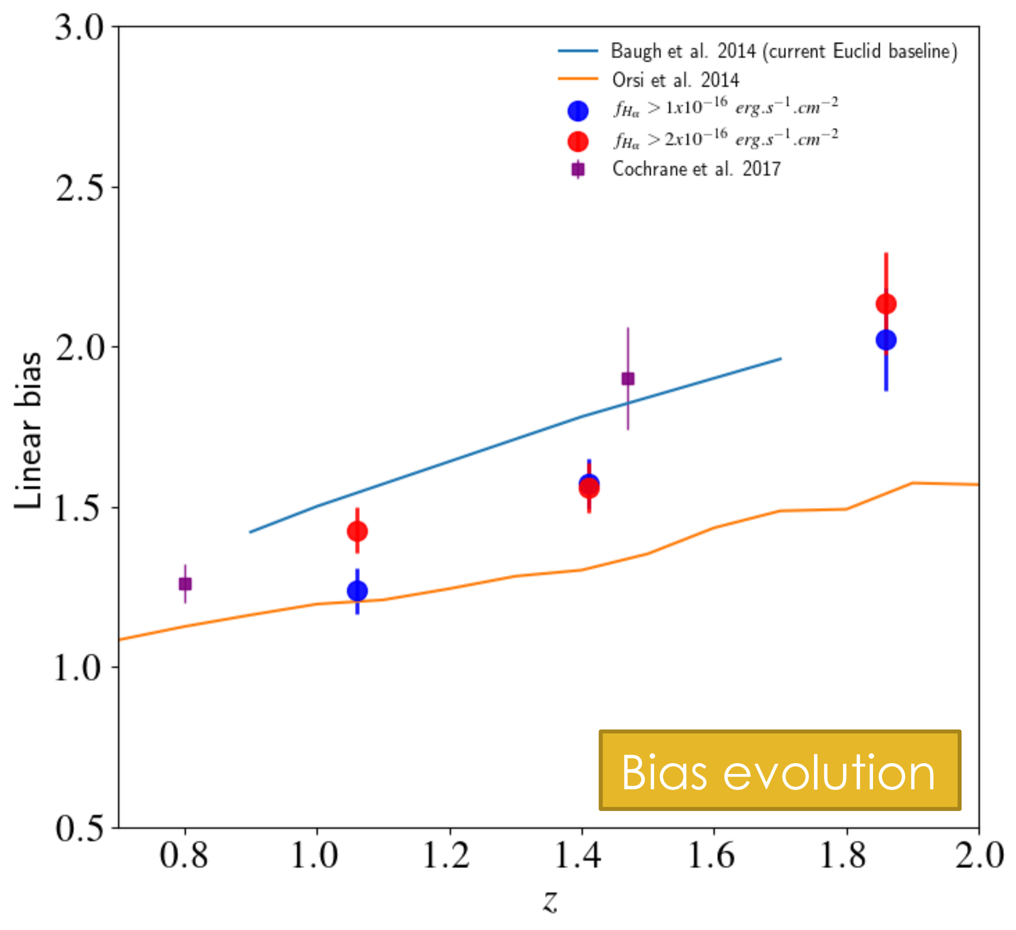


Gonzalez-Perez+ '18 (SAM)

Clustering & halo modelling

Preliminary

- Derived HOD parameters
  - Effective large-scale bias at different redshifts
  - Luminosity thresholds to reproduce flux selections at 1 & 2e-16 erg/s/cm^2
  - Bias increase with redshift by about 50% from z=0.9 to z=1.8
  - Bias 20% smaller then predicted by SAM



de la Torre et al., in prep.