New insights on the evolution of EW(Ha) and sSFR up to z~5

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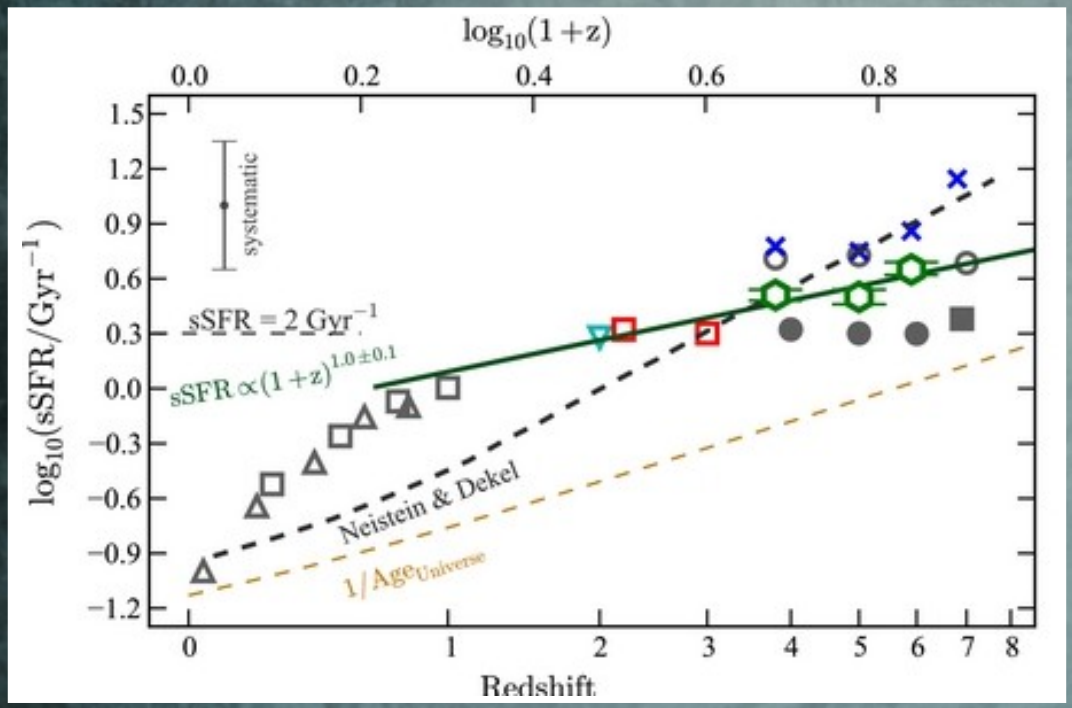
The early growth of galaxies: The HST, Spitzer and Herschel joint legacy
Sesto, Italy 11 January 2016

Motivation: about sSFR

Gonzalez+2014



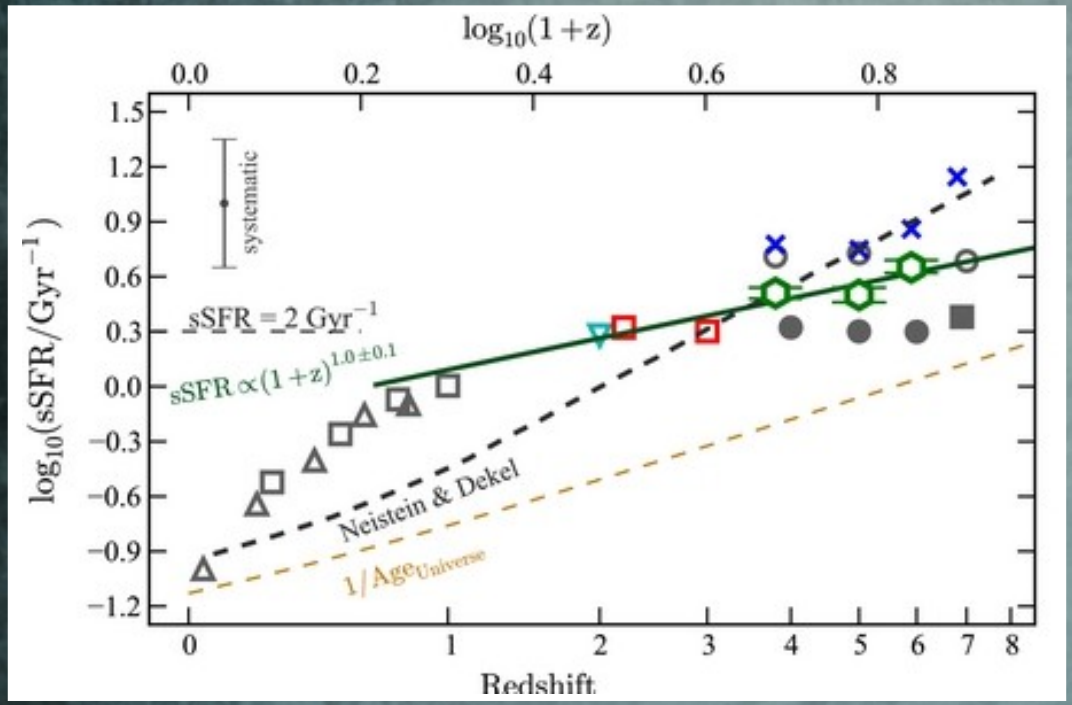
Numerical simulations and semi-analytic models predict that the sSFR should closely match the inflow rate of baryonic material: $\propto (1+z)^{2.25}$

(e.g Dekel+2009)

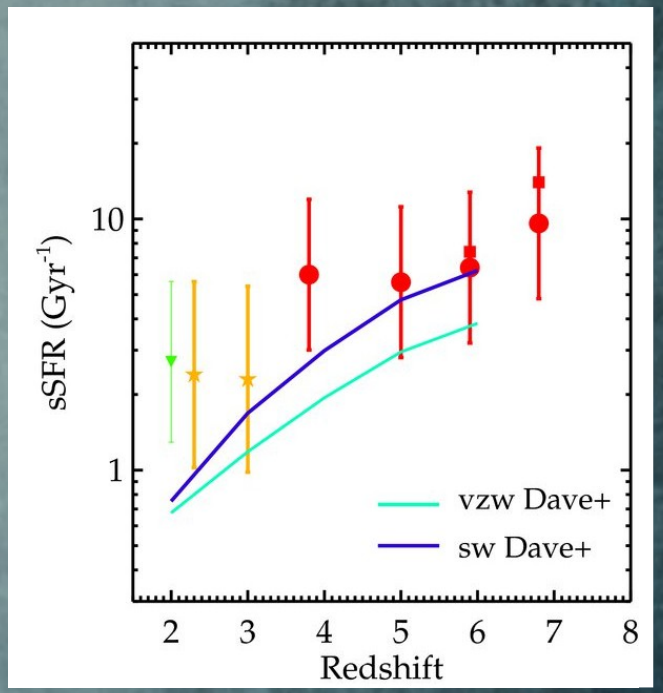
Expected increase of 10x in sSFR in galaxies of fixed stellar mass over 2<z<7

Motivation: about sSFR

Gonzalez+2014



Stark+2013

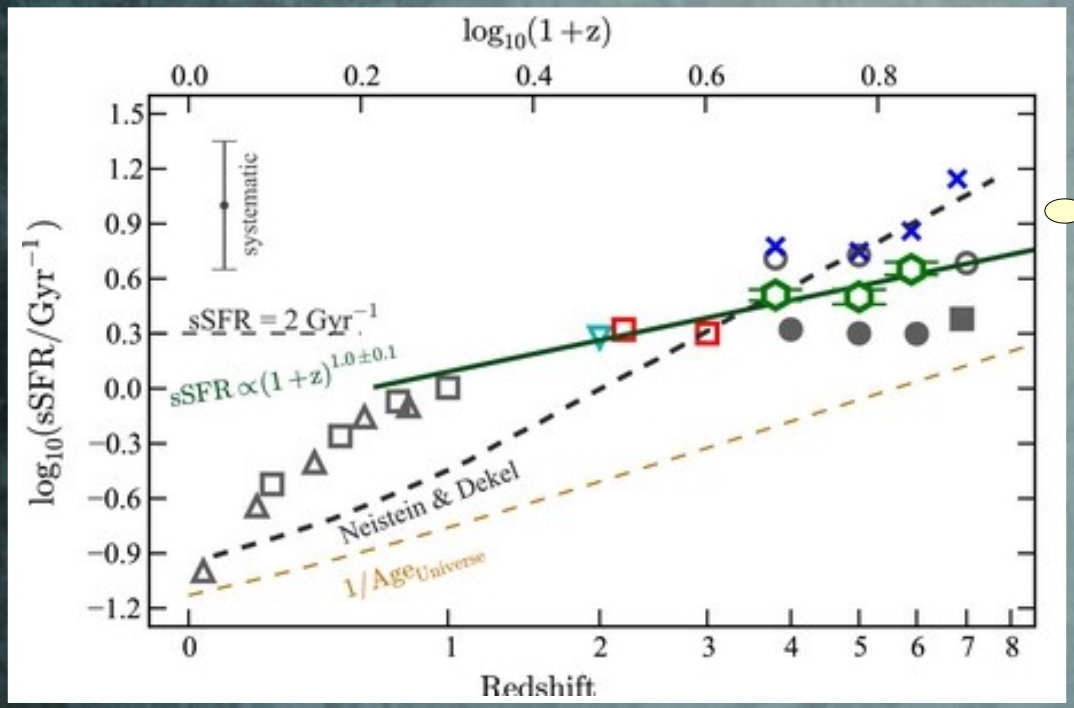


Dave+2011 models including feedback: better constrains at high z but fail at lower z

See also Lehnert+2015

Motivation: about sSFR

Gonzalez+2014

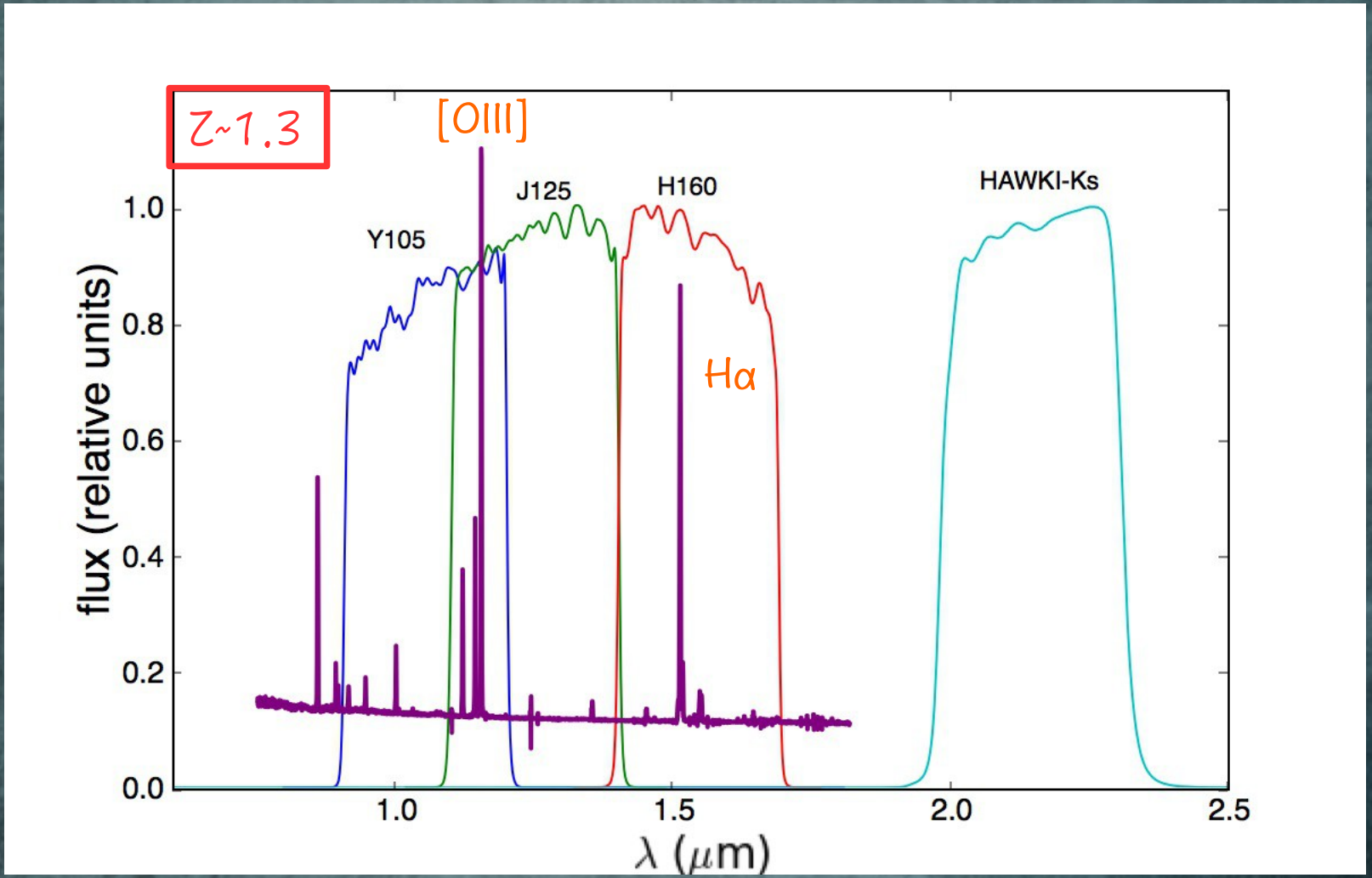


sSFR=SFR/M
$M_{stellar}$, SFR:
SED fitting?

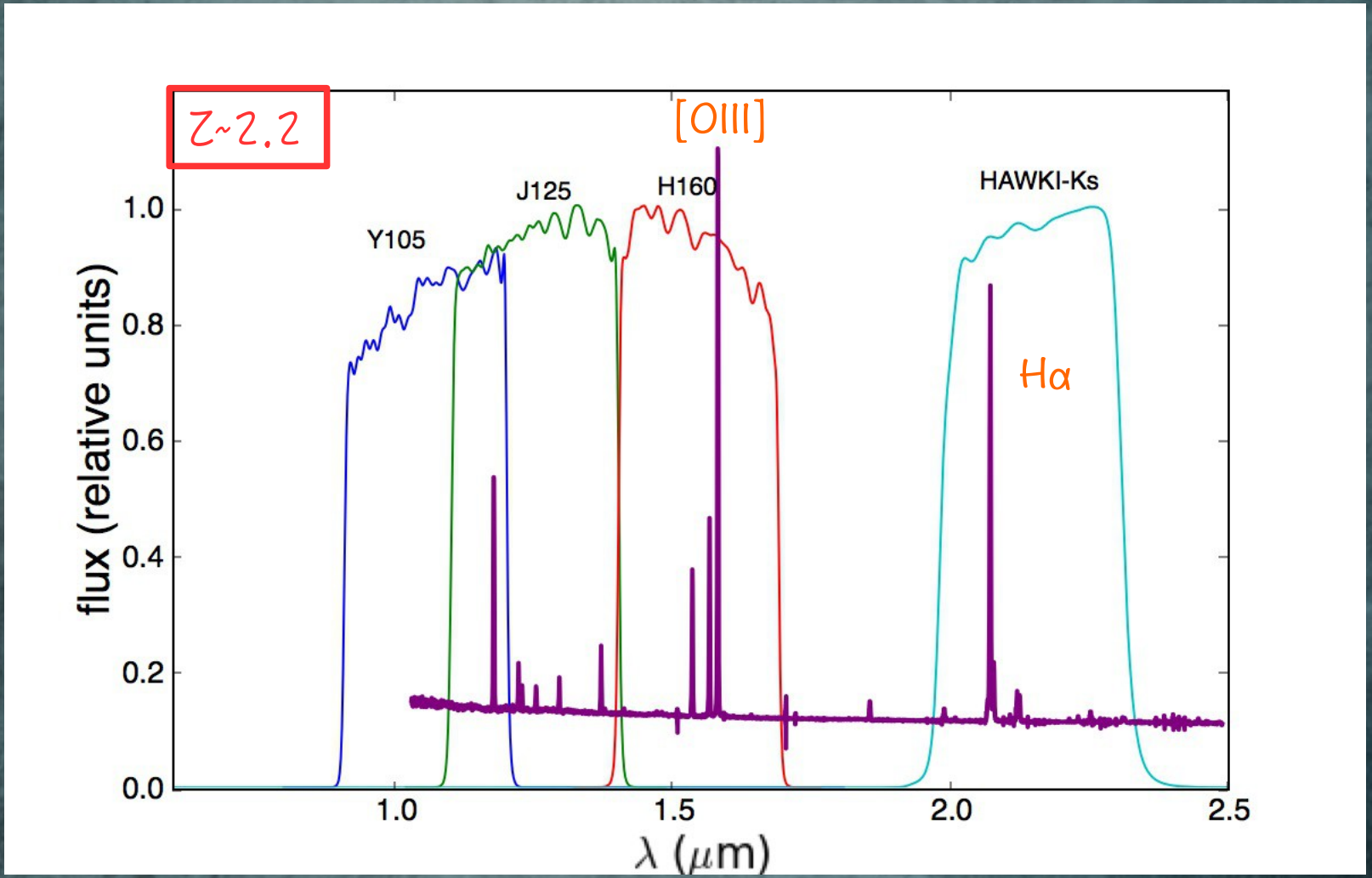
SFH
Stellar population models
IMF
Dust attenuation

Nebular emission

Impact of the nebular emission?

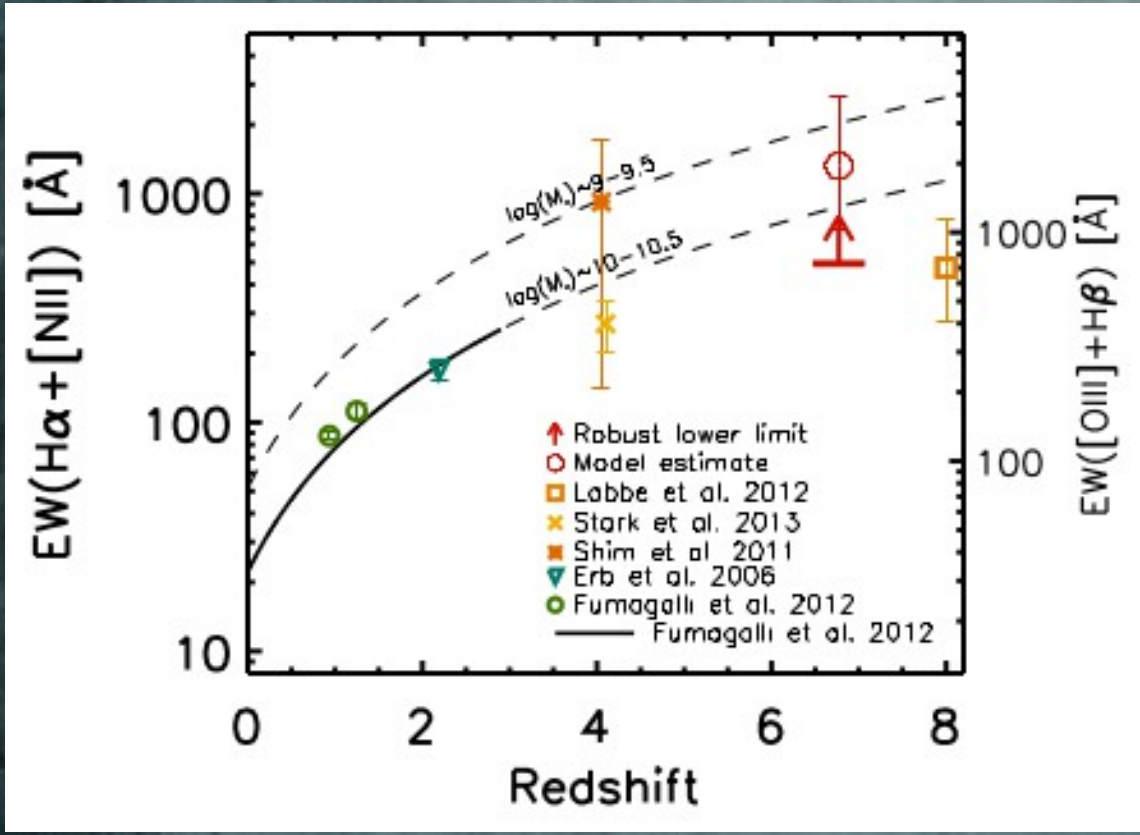


Impact of the nebular emission?



Motivation: about EW(Hα)

Smit+2014



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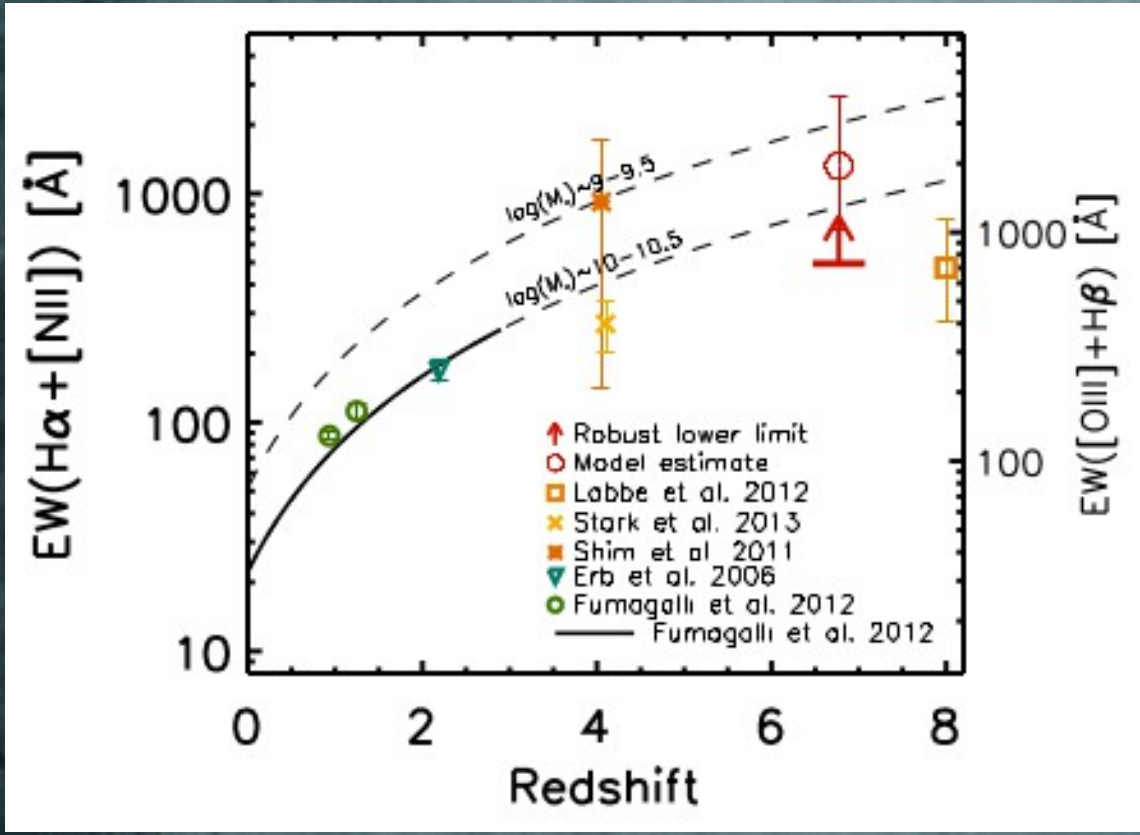

$EW = F(H\alpha)/f_{cont}$

$F(H\alpha) \sim SFR$

$f_{cont} \sim M_{stellar}$

EW(Hα) a reasonably proxy for the sSFR

Observed increase of 5x

>>Compatible with the evolution at z<2

>>Incompatible with sSFR

Can we understand the evolution of EW(Hα) and sSFR simultaneously?

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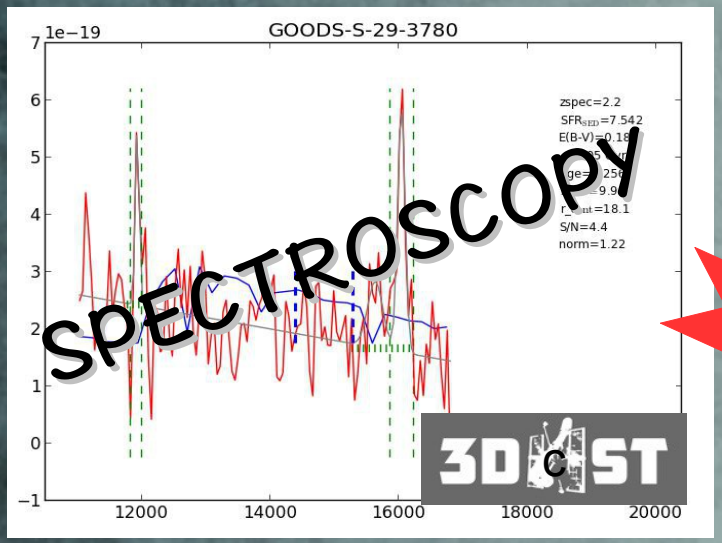
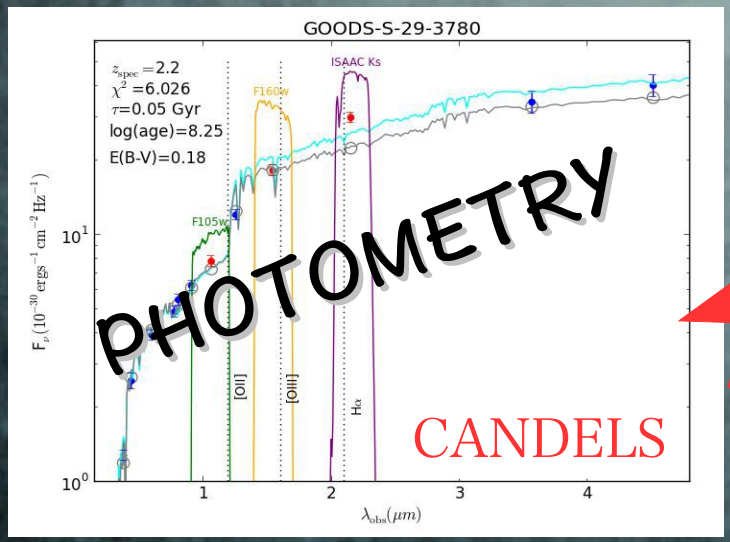




Can we infer EWs?

Trace evolution

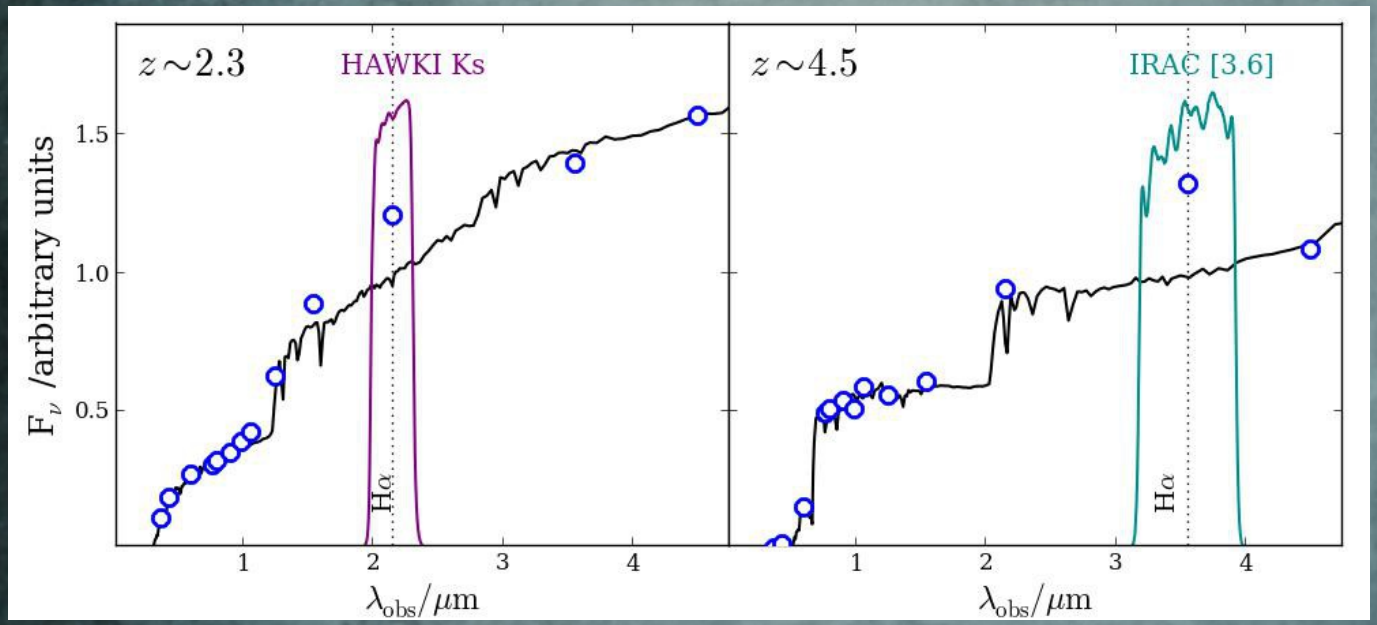
- EW(Hα)
- sSFR

Photometric data: CANDELS

GOODS-S: Guo+2013
UDS: Galametz+2013

>>> Deep HAWKI-Ks data from the HUGS survey (Fontana+2014)

>>> Spectroscopic redshifts



Bruzual & Charlot2003
Chabrier IMF
Exp declining τ SFH
Solar/subsolar metallicity
Calzetti law

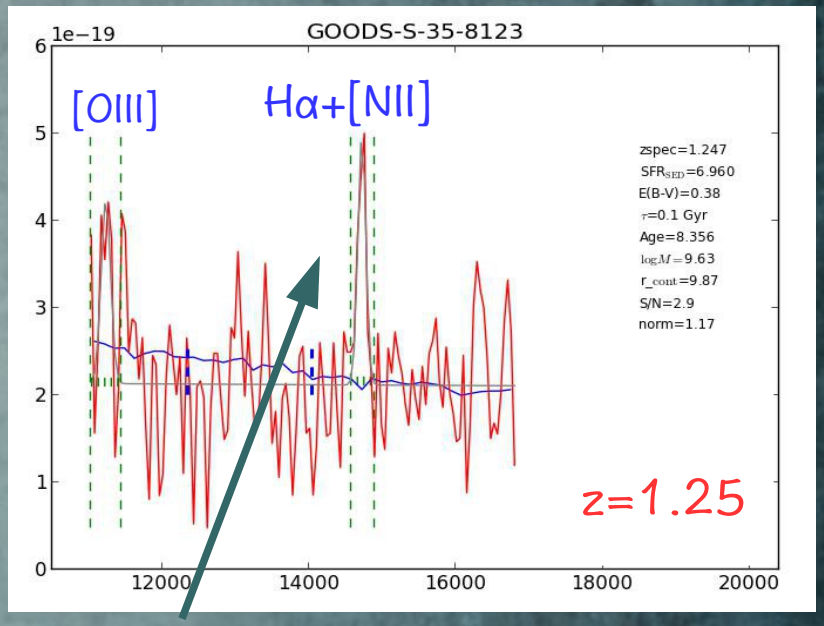
A clear flux excess is detected in the photometric bands where the nebular emission lines are expected: flux in the continuum from the SED

9.5 < logM < 10.5

Spectroscopic data: 3D-HST Brammer+2012

Low-resolution nIR spectra with the WFC3 G141 grism on the HST

48 star-forming galaxies



Emission line fluxes Fsp

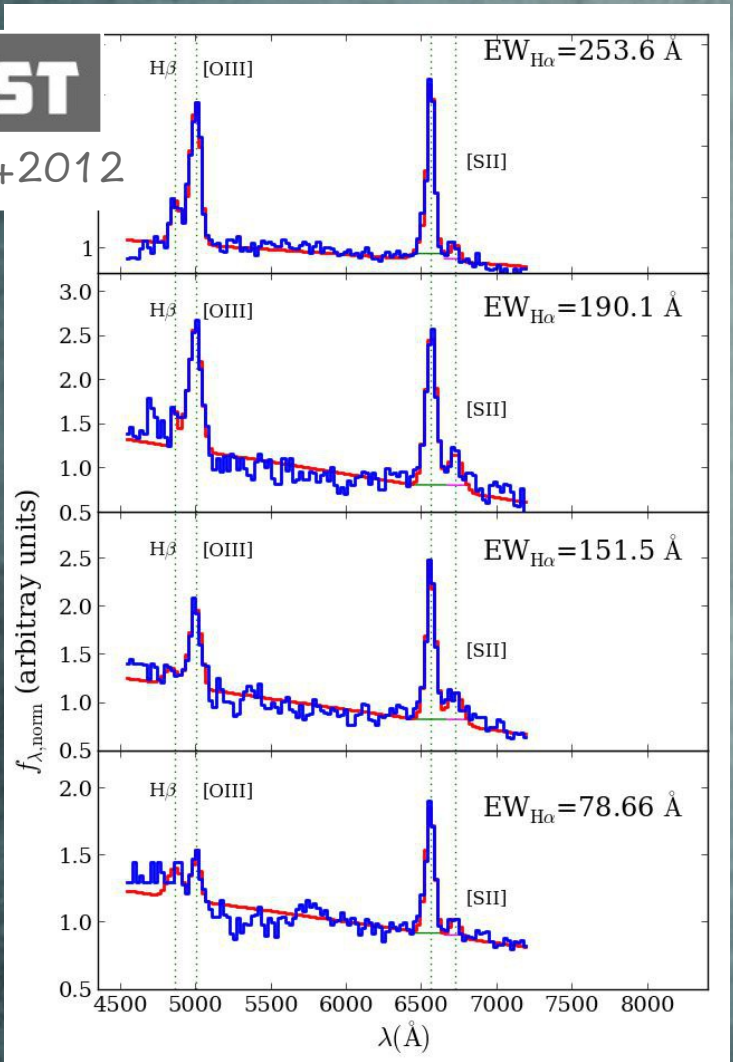
A modified version of the publicly available pipeline (Cullen+2014)

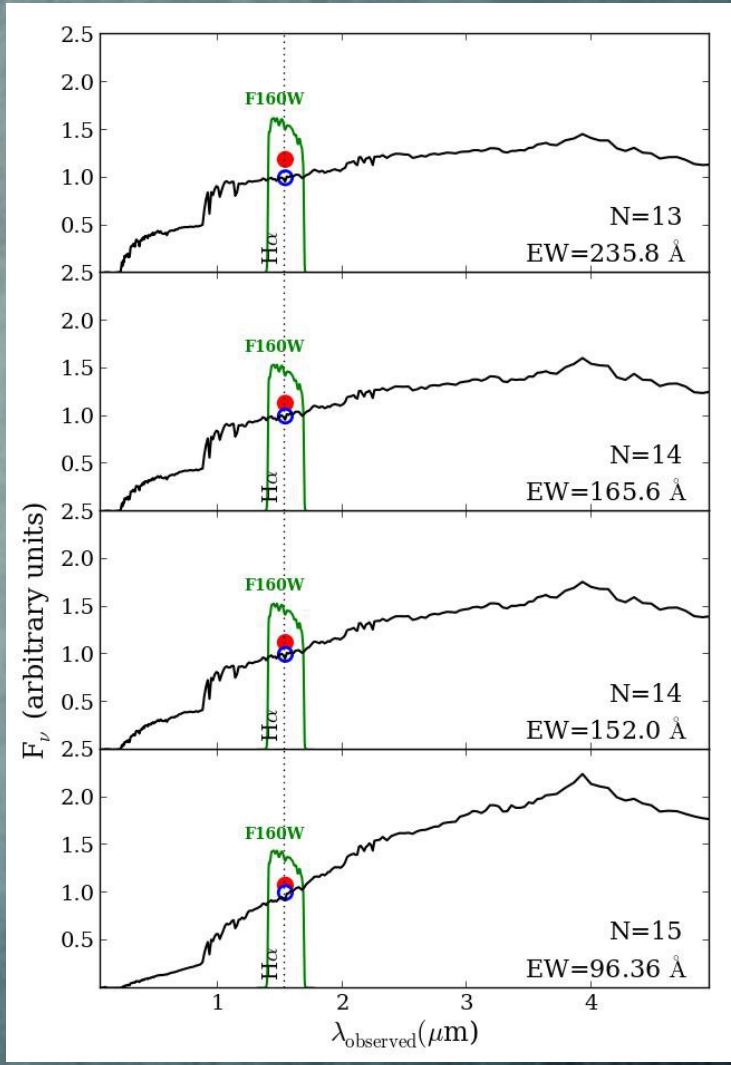
9.5 < logM < 10.5

Testing with SF galaxies at z~1.3

3D-HST

Brammer+2012



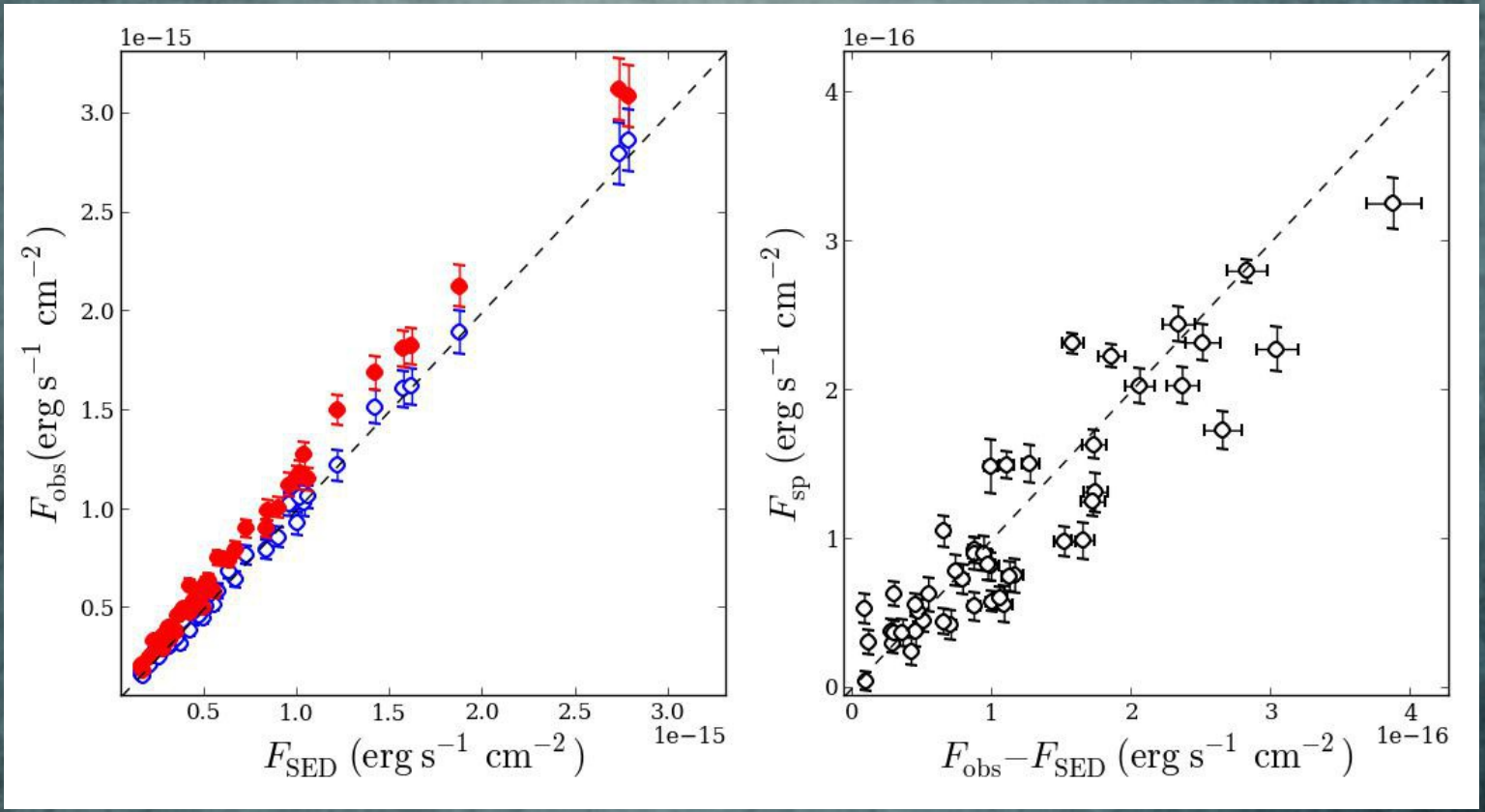


Low-resolution nIR spectra with the WFC3 G141 grism on the HST

9.5 < logM < 10.5

Testing with SF galaxies at z~1.3

Recovering fluxes



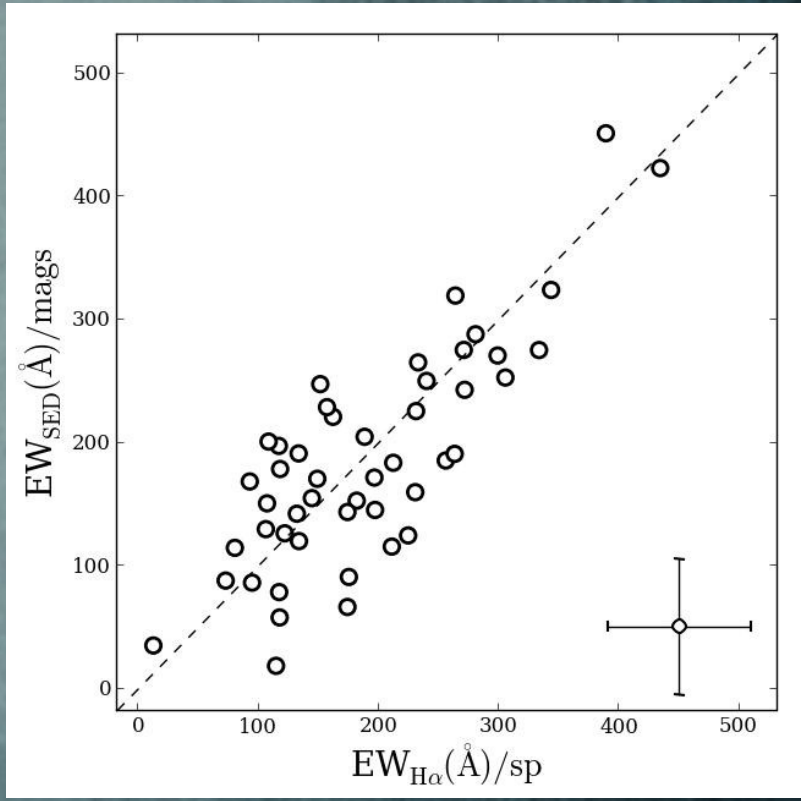
FSED: estimate of the continuum flux

Fsp: measured over the spectra

9.5 < logM < 10.5

Testing with SF galaxies at z~1.3

Recovering EWs



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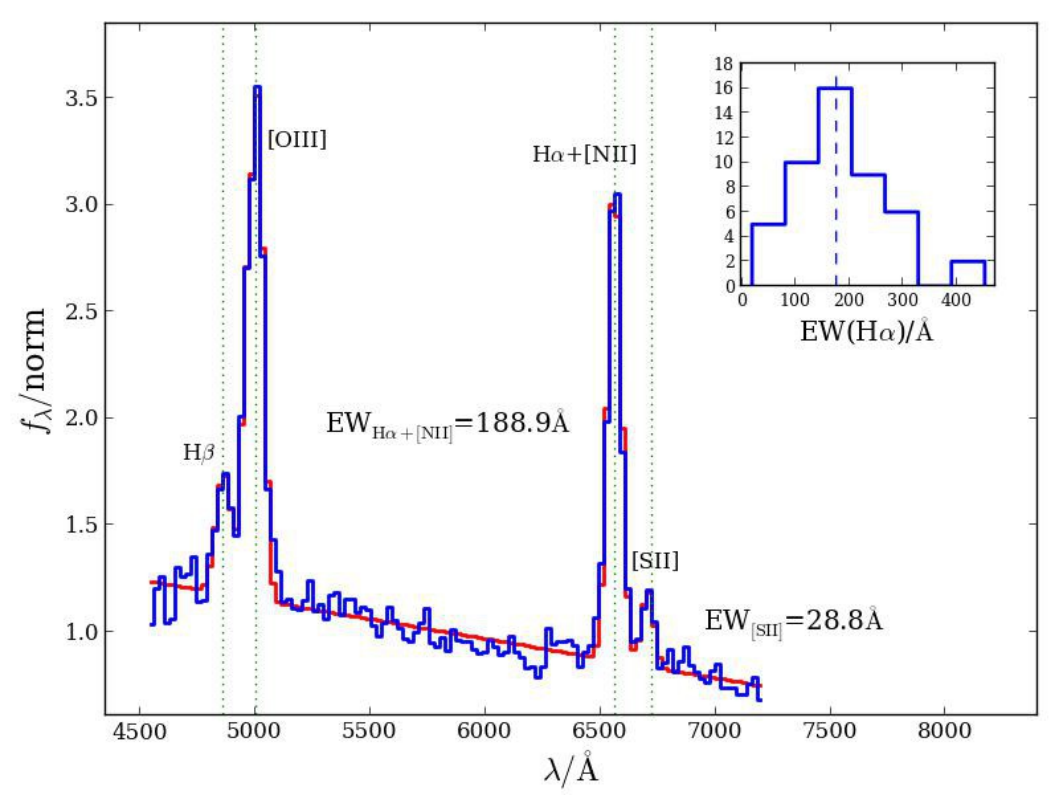
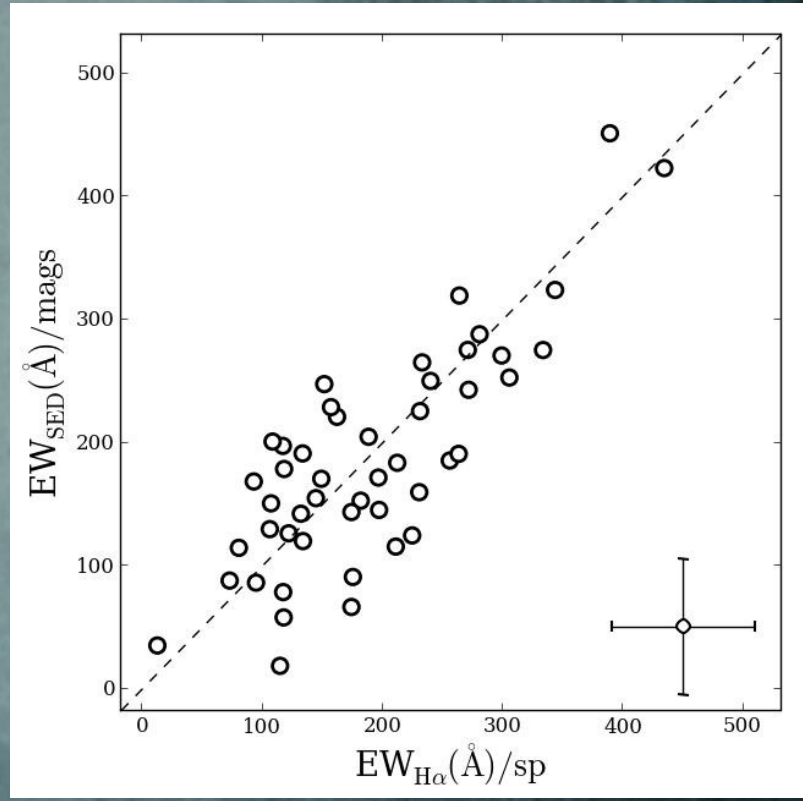
Testing with SF galaxies at z~1.3

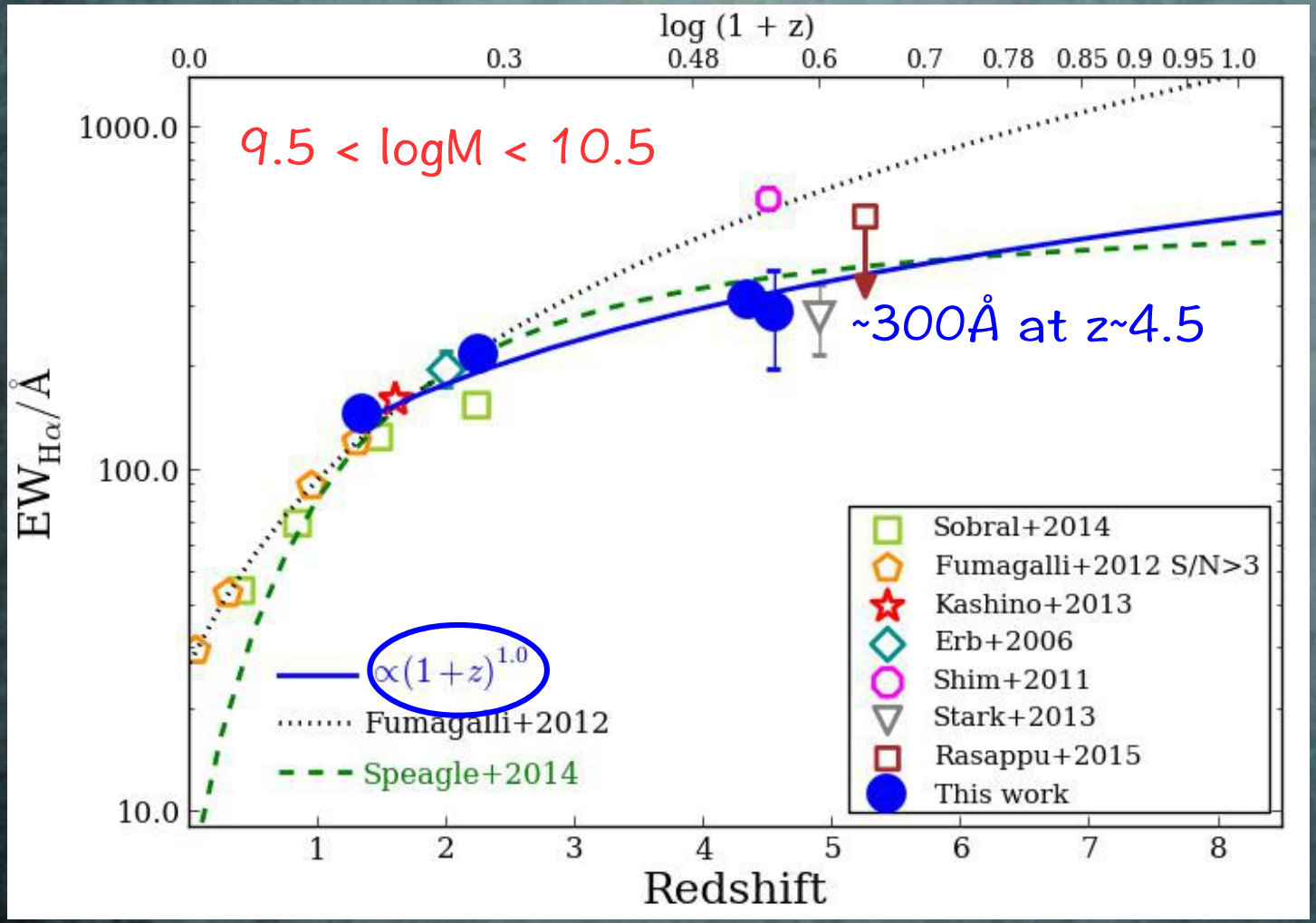
Recovering EWs





EW(Hα) vs redshift

Modest evolution of EW(Hα)



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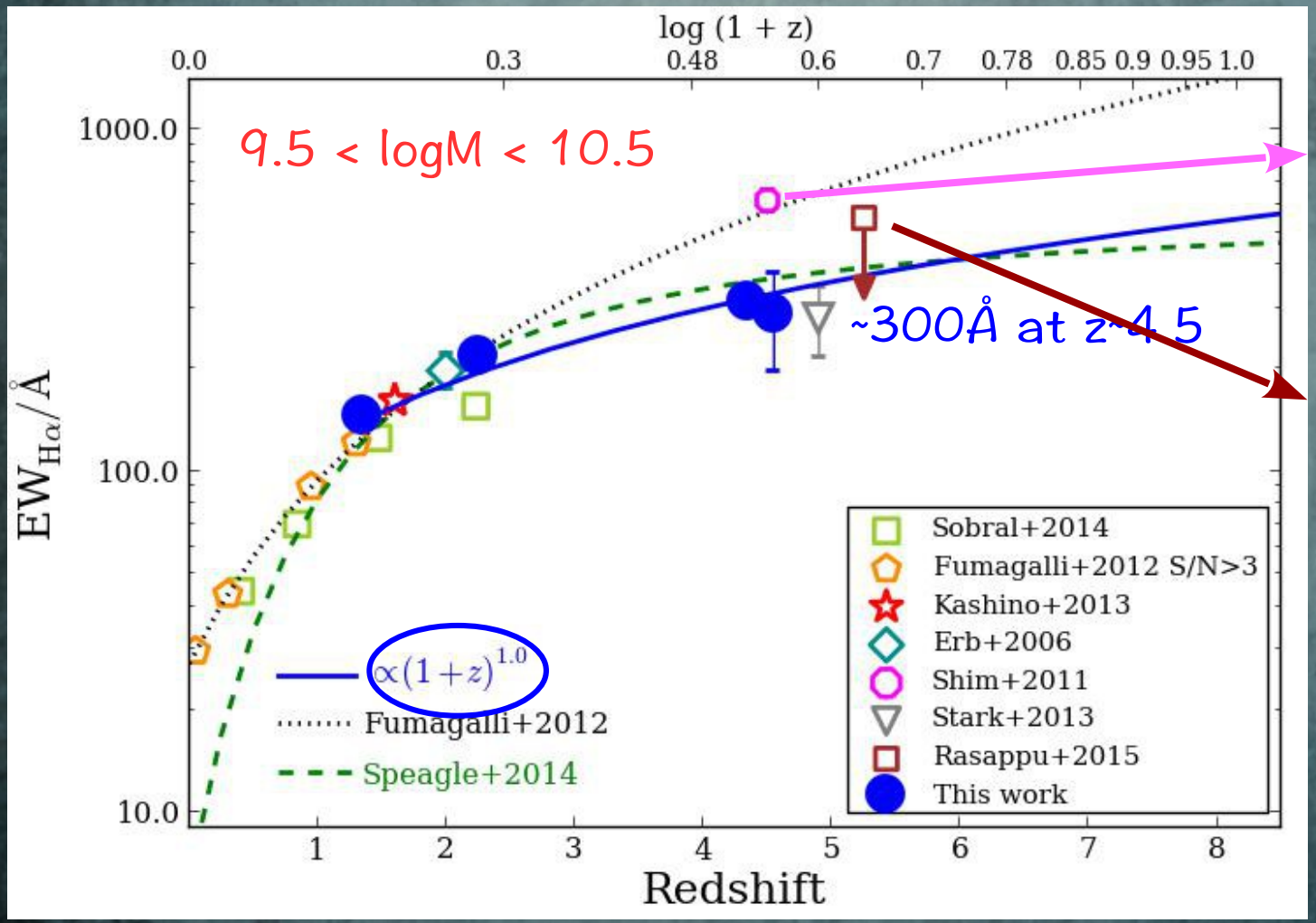

Shim+2011
~0.2dex brighter
IRAC [3.6]

Rasappu+2015
Median LogM~9.1

EW(Hα) vs redshift

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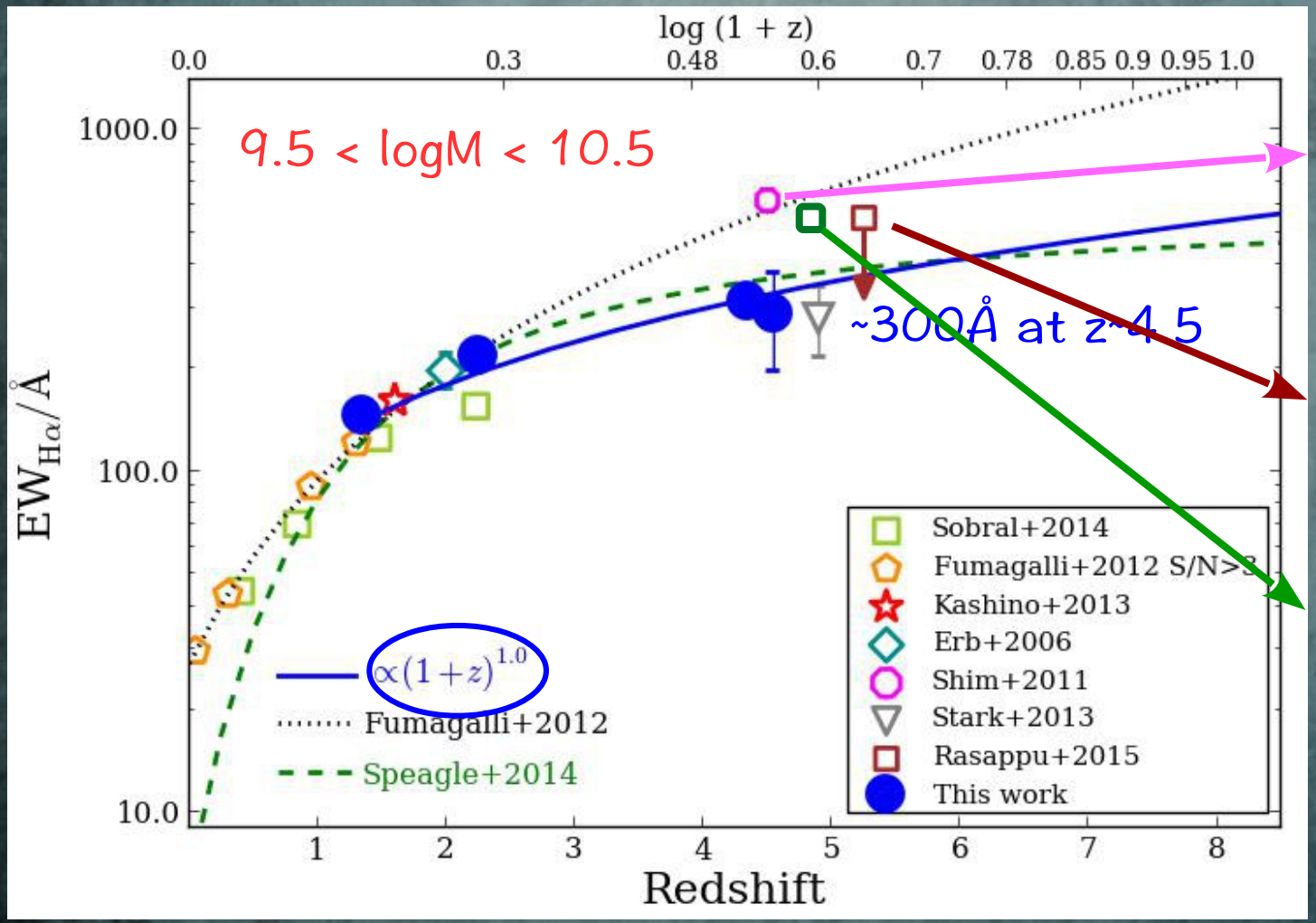
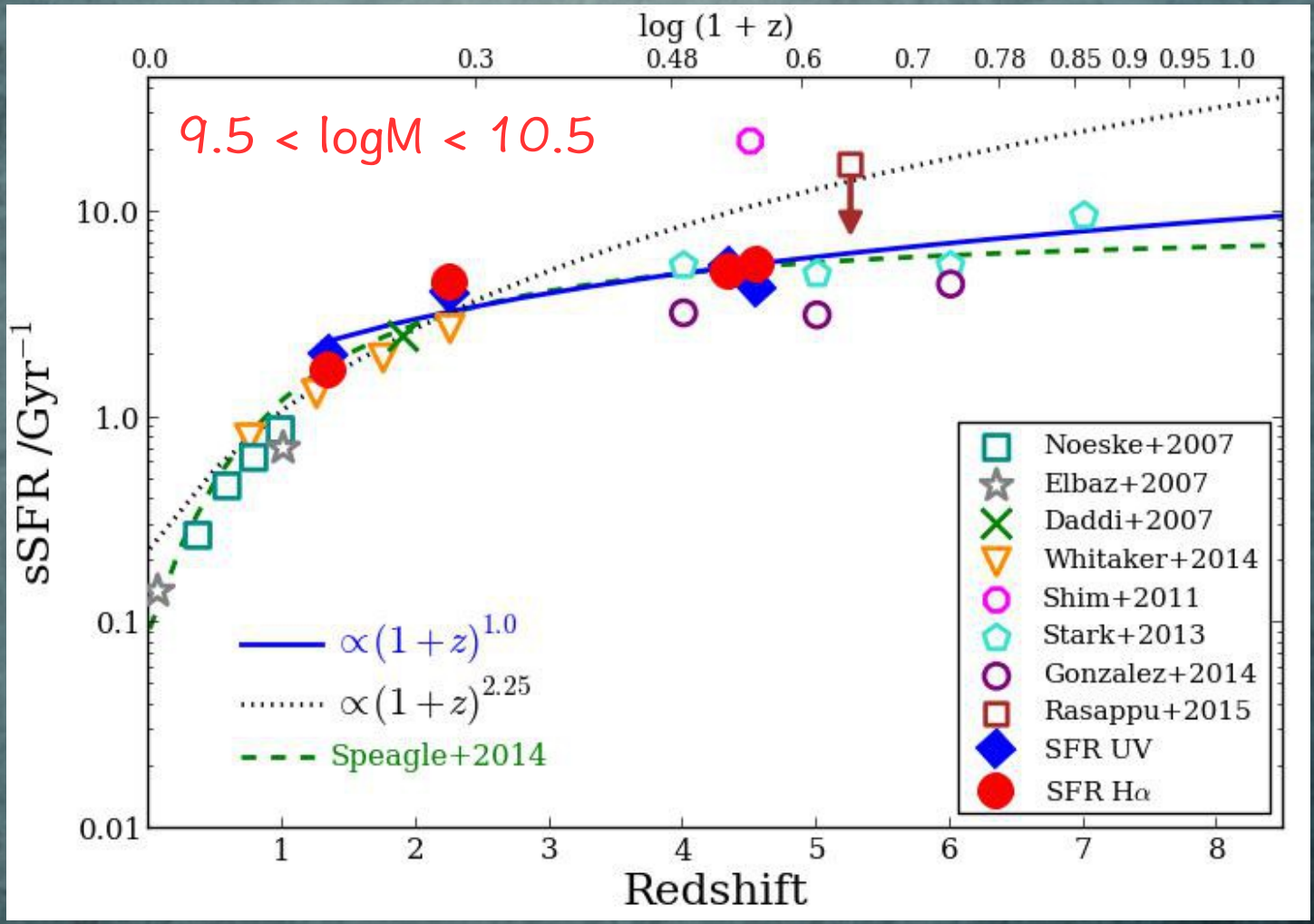


Shim+2011
~0.2dex brighter
IRAC [3.6]

Rasappu+2015
Median LogM~9.1

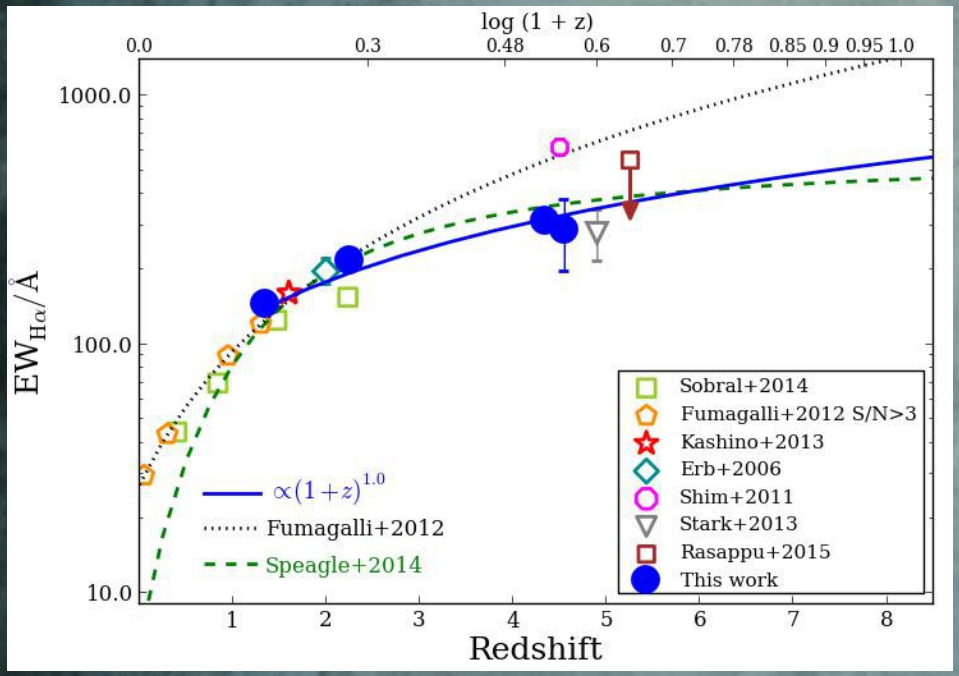
Smit+2016
Median LogM~9.0

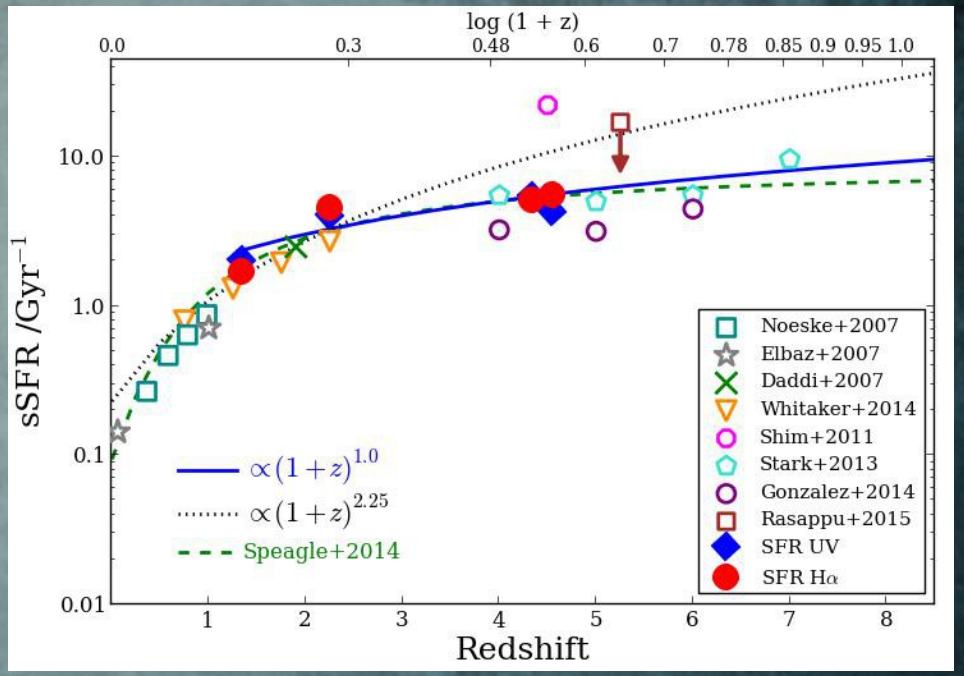
sSFR vs redshift



Can we understand the evolution of EW(Hα) and sSFR simultaneously?

The evolution of the EW(Hα) and sSFR with z is consistent





$$EW(H\alpha)/Å = (63 \pm 7) \times sSFR/Gyr^{-1}$$

EW(Hα) provides a useful independent tracer of sSFR for star-forming galaxies out to z = 5


THANK YOU!
http://mygalaxies.co.uk