BlueMUSE: linking high- and low-z via Extreme Emission Line Galaxies

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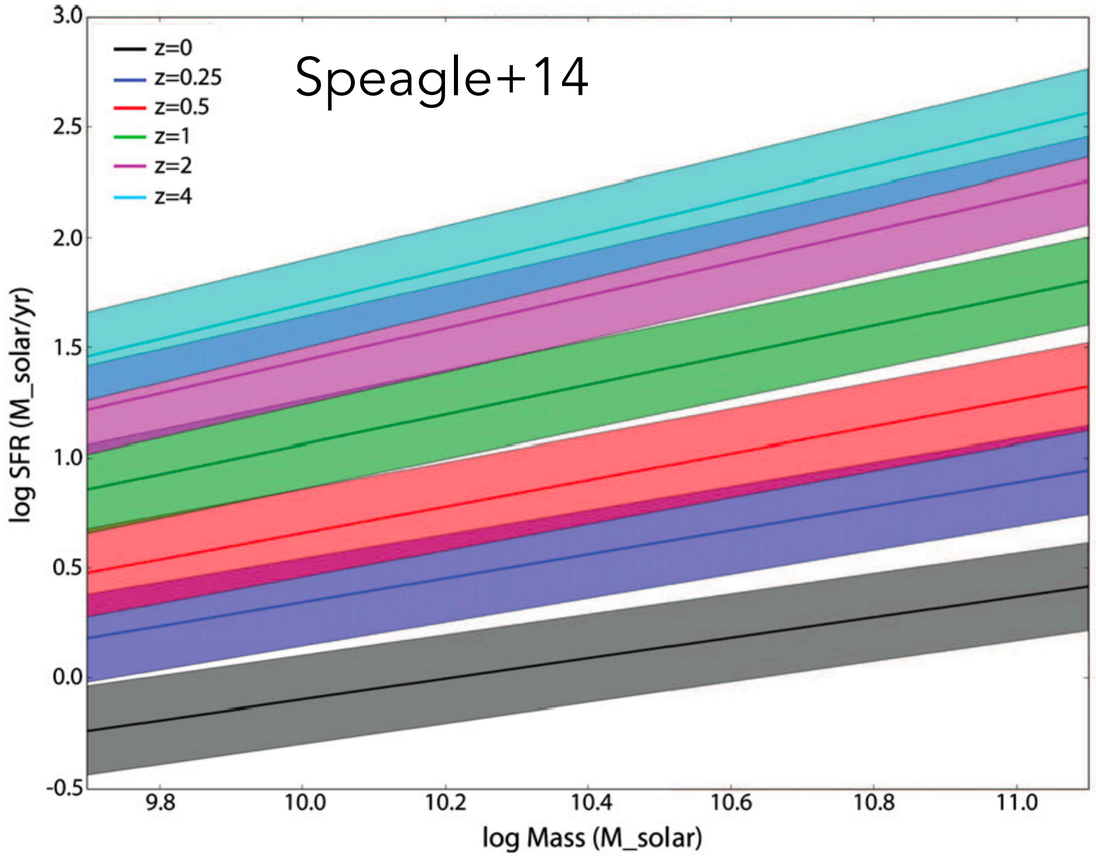
OUTLINE

- Star formation in low-mass galaxies across redshift
- The importance of un-targeted samples via (Blue)MUSE and slitless grism spectroscopy
- The relationship between young starbursts and (ionizing) photon escape
- Prospects for building on what JWST will show us

THE GLOBAL GALAXY POPULATION EVOLVES WITH Z

- At high *z*, galaxies are, at fixed stellar mass:
  - Younger
  - More metal poor
  - Have higher SFRs

(see also Brinchmann+04, Noeske+07, …)



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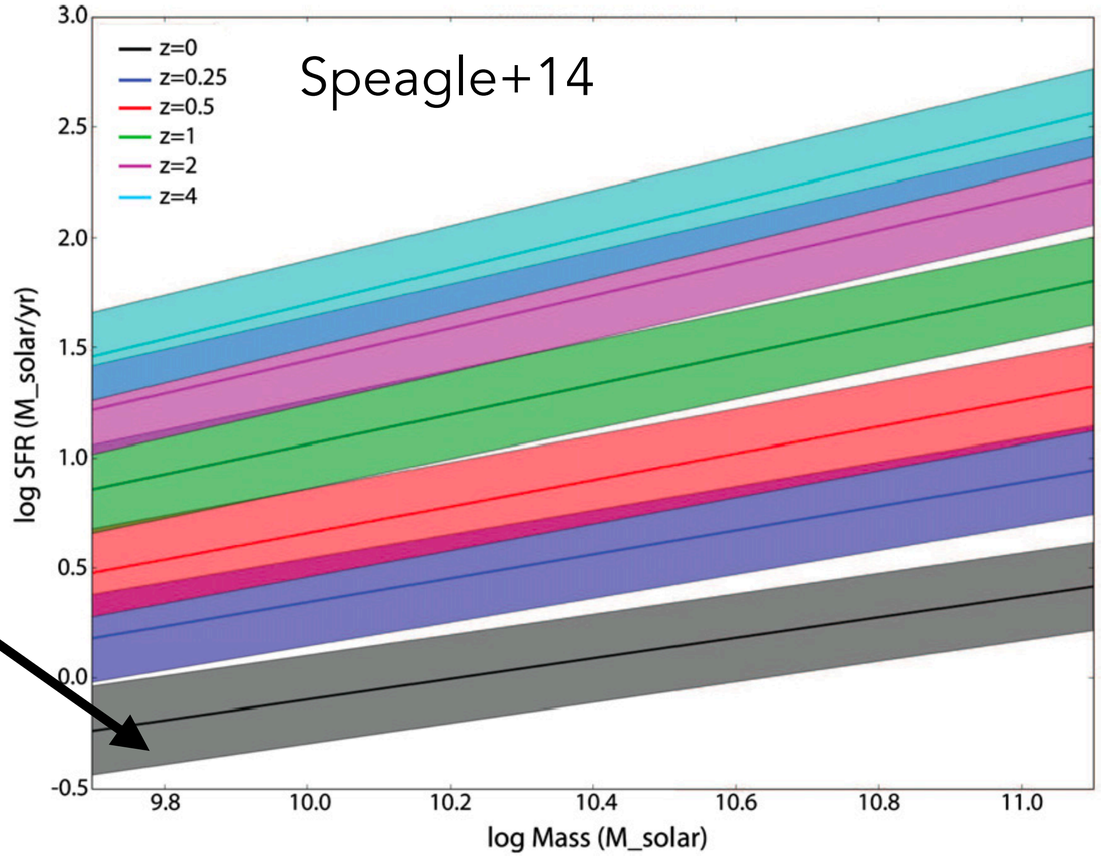
But what happens at low masses?

$10^{9.8}$ $M_\odot$



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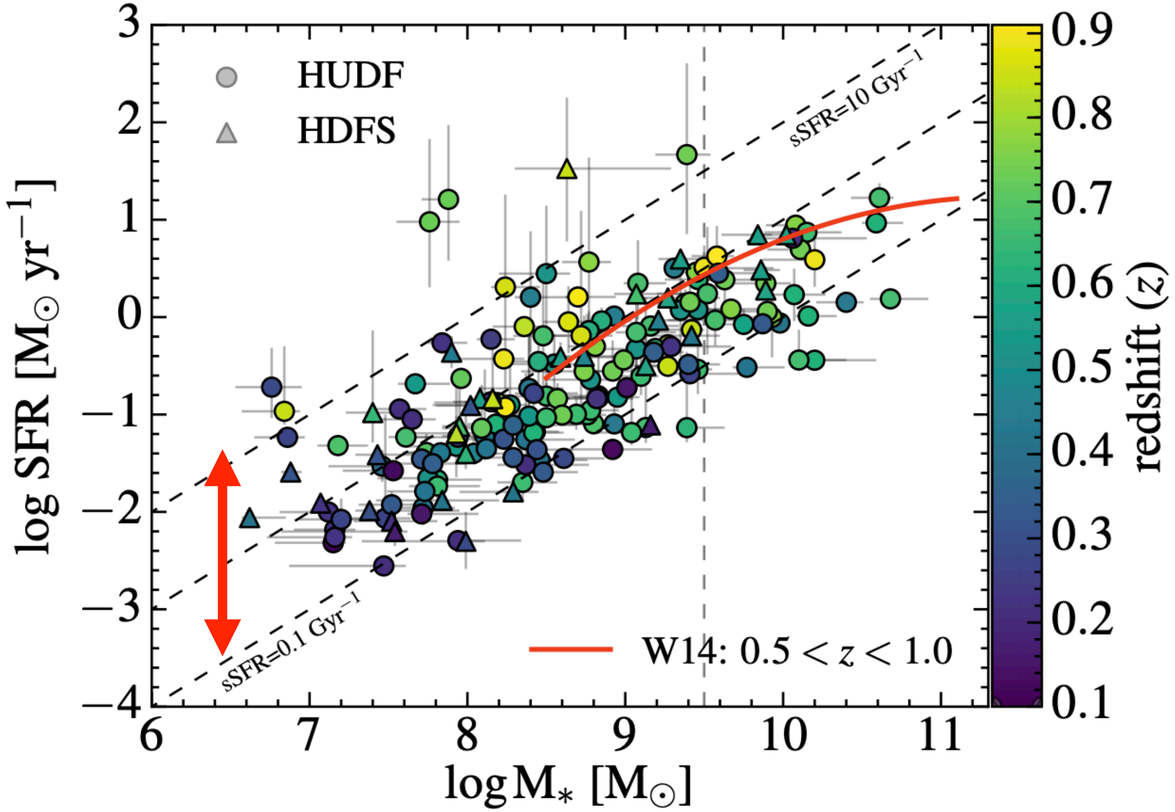
But what happens at low masses?

- Scatter seems to increase, with numerous outliers above the sequence

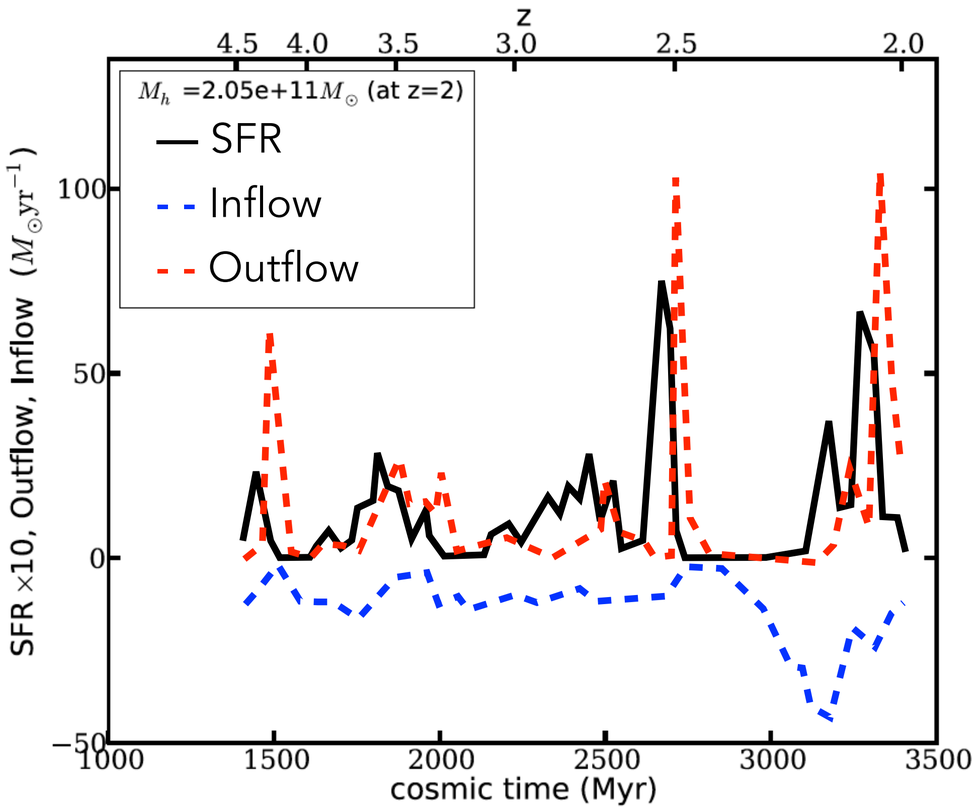
Boogaard+18; z < 1

(using 2 sq. arcmin from MUSE)



STAR FORMATION HISTORIES OF LOW MASS GALAXIES

- At low masses and high redshift, star formation is expected to proceed differently
- Short, intense bursts of star formation are the norm according to simulations
  - Self-regulating bursts due to strong SNe feedback

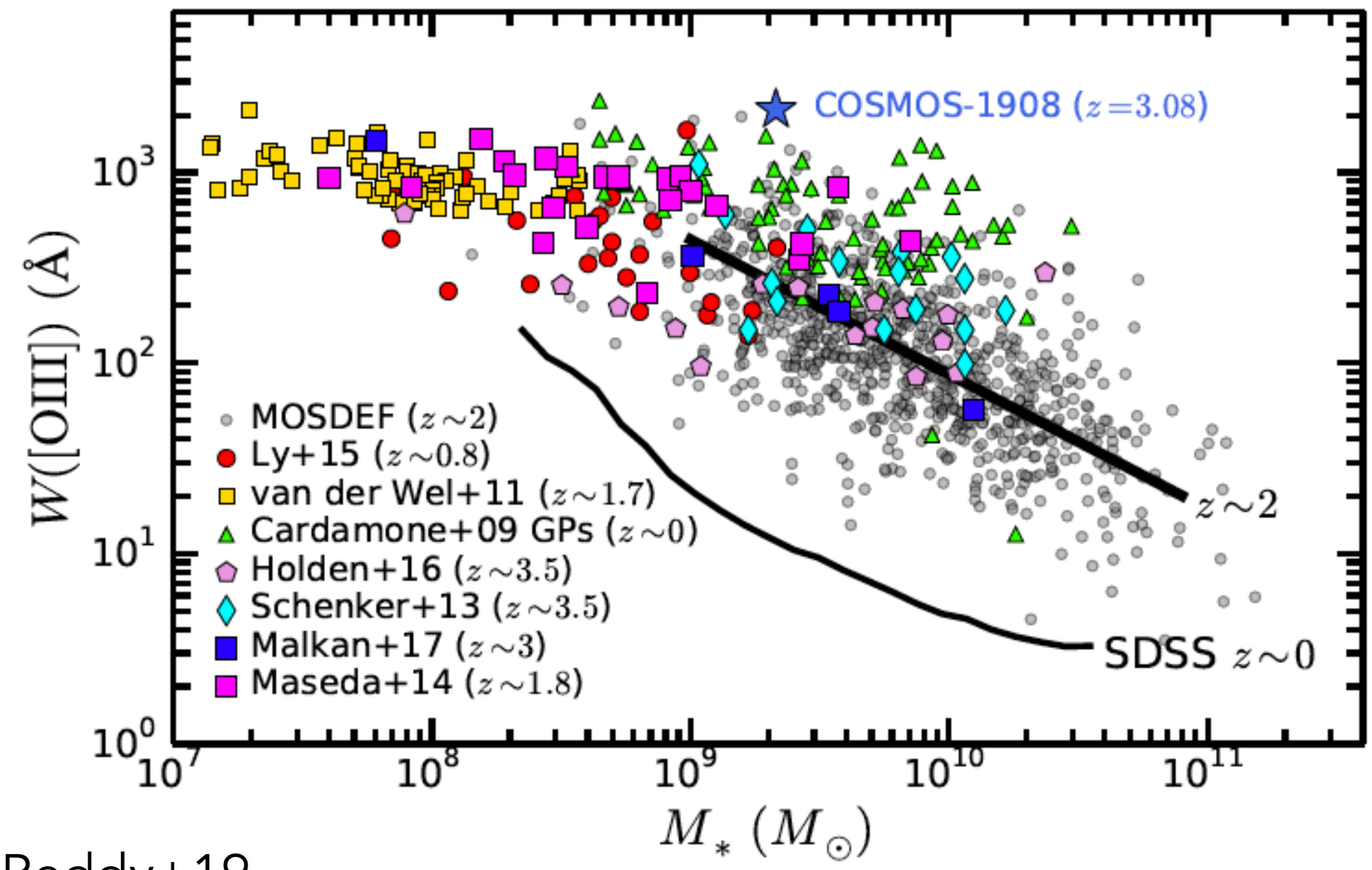


Muratov+15

(see also Shen+14, …)

HOW WOULD WE OBSERVE LOW-MASS STARBURSTS?

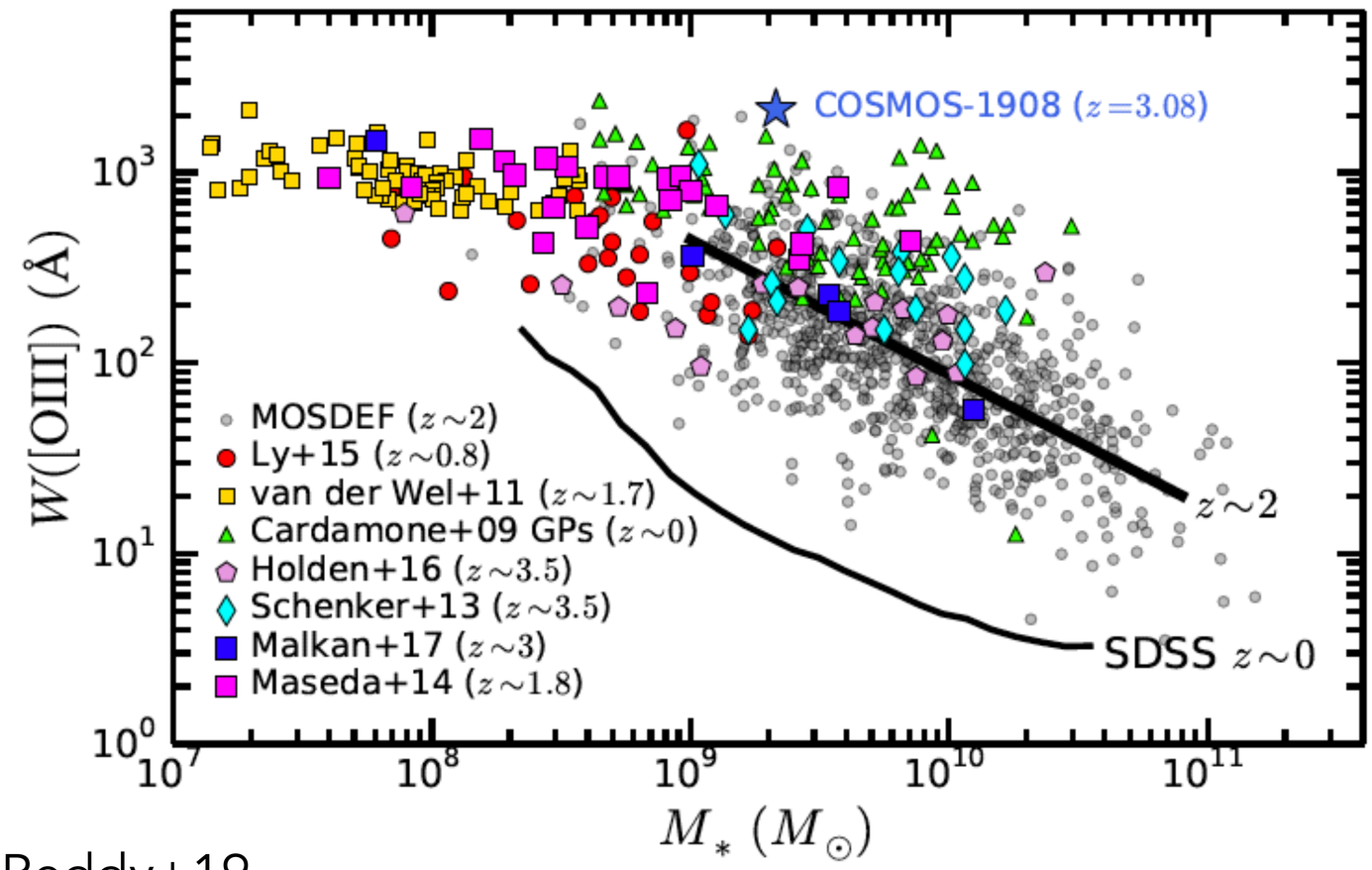
- Short, intense star formation leads to strong emission lines like [OIII] and Hα
  - Large equivalent widths (> 100-200 Å)



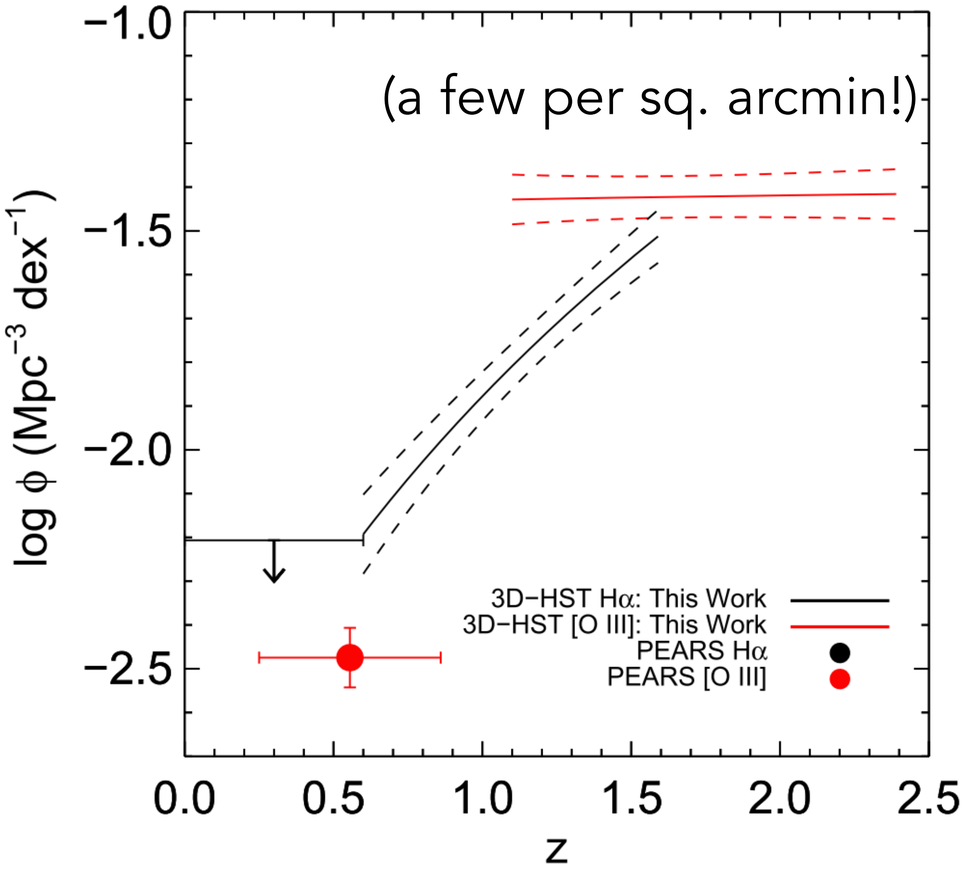
Reddy+19

HOW WOULD WE OBSERVE LOW-MASS STARBURSTS?

- Short, intense star formation leads to strong emission lines like [OIII] and Hα
  - Large equivalent widths (> 100-200 Å) are more common at z > 1



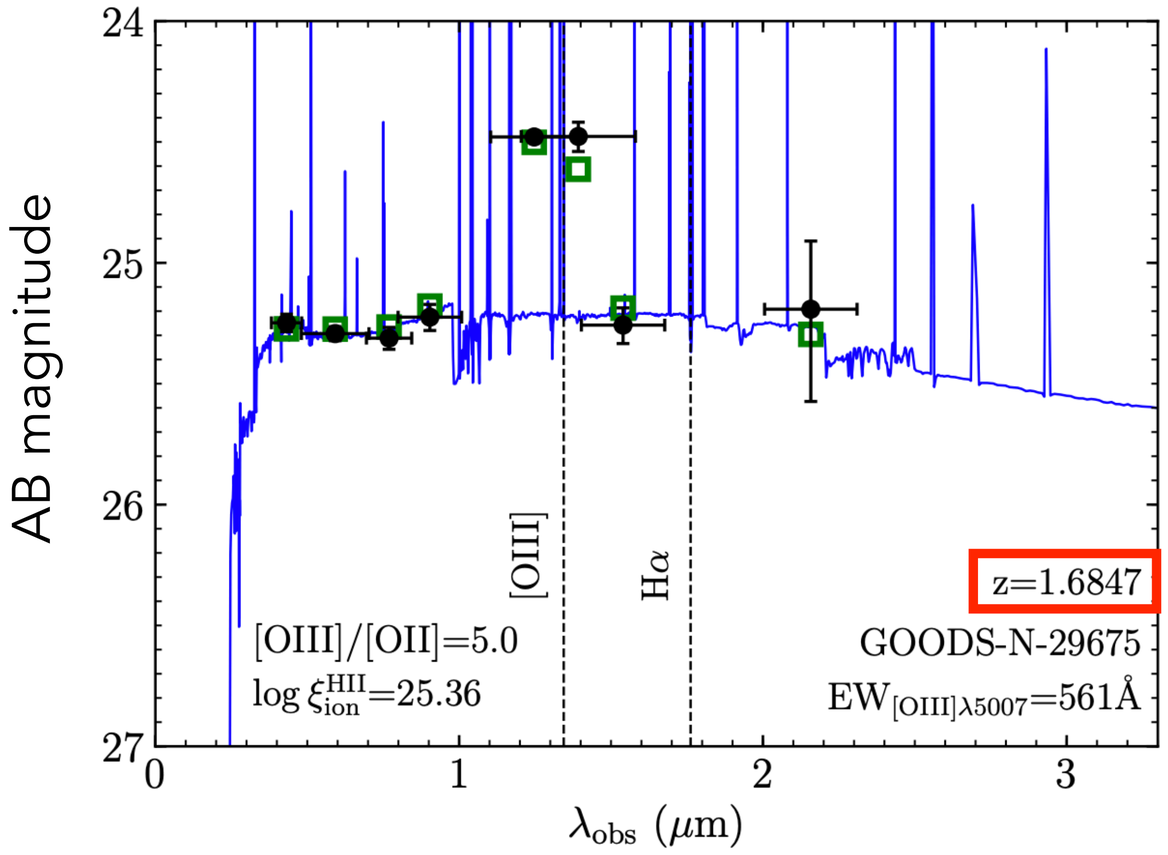
Reddy+19



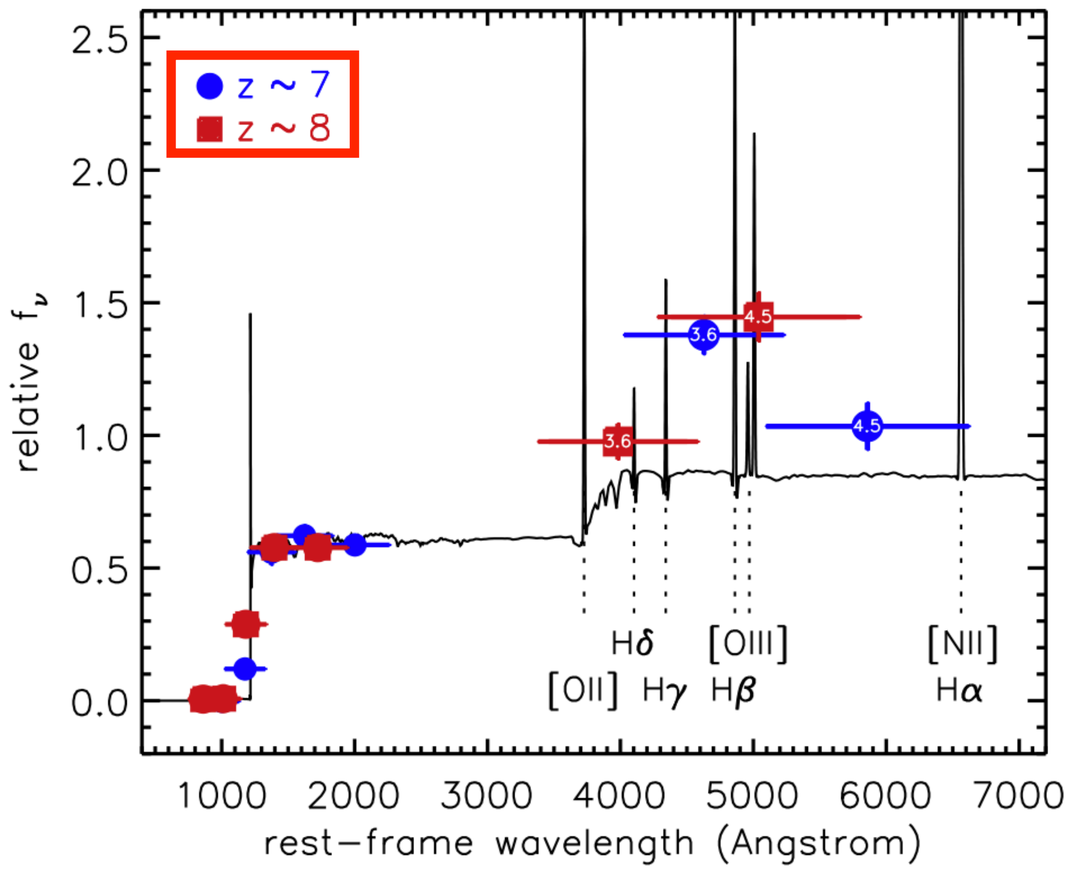
Maseda+18a

THOSE GALAXIES CAN BE ANALOGUES TO HIGH-Z GALAXIES

- Bursty star formation is the *norm* at high-z

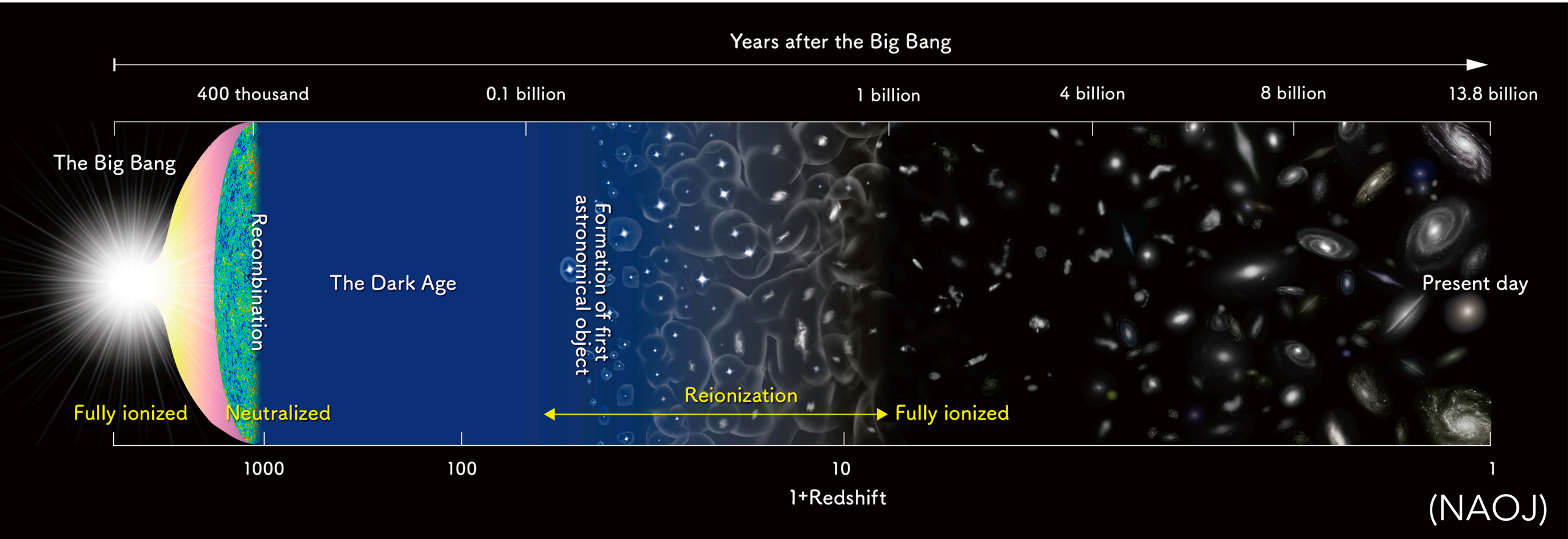


Tang+18



Labbe+13

BURSTS COULD BE CRUCIAL IN UNDERSTANDING REIONIZATION

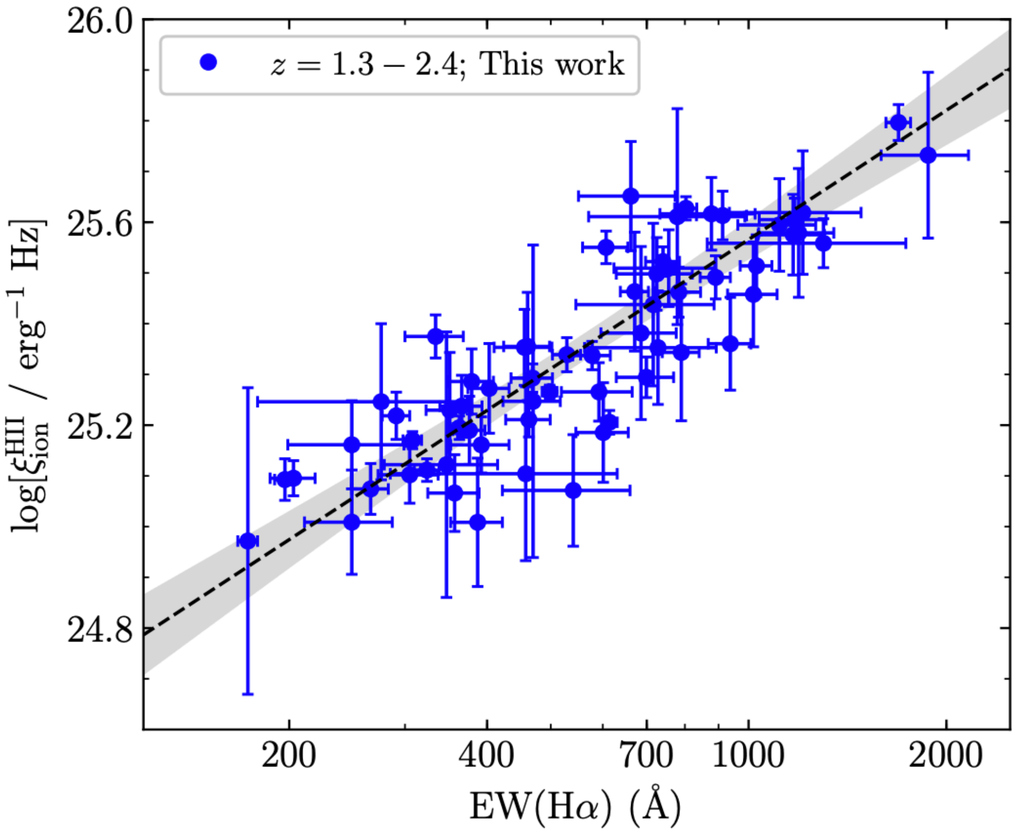


(NAOJ)

BURSTS COULD BE CRUCIAL IN UNDERSTANDING REIONIZATION

- Bursts produce a lot of ionizing photons

(ratio of ionizing to non-ionizing photons)

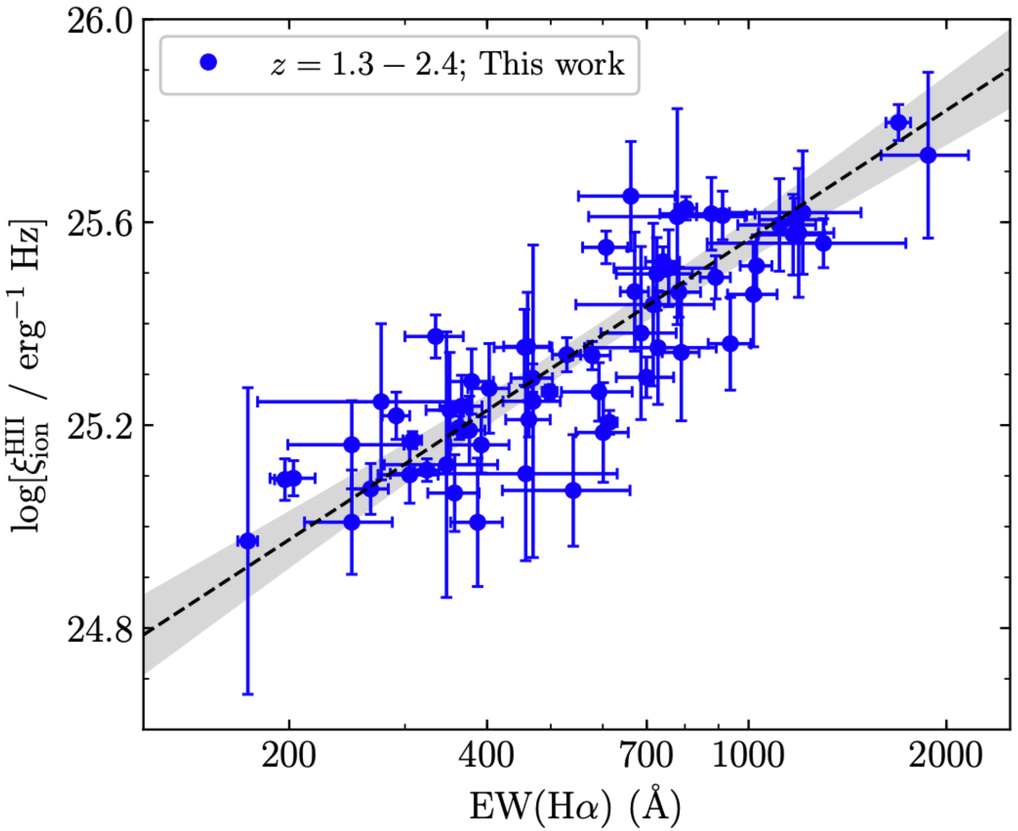


Tang+18

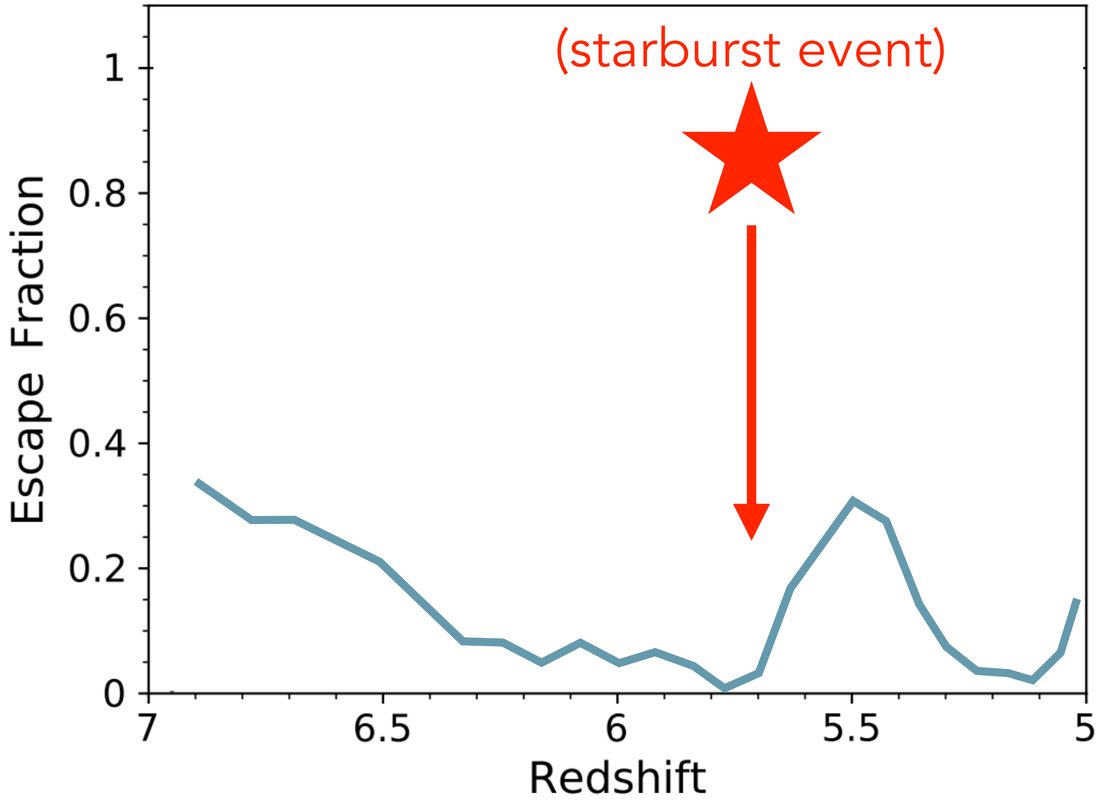
BURSTS COULD BE CRUCIAL IN UNDERSTANDING REIONIZATION

- Bursts produce a lot of ionizing photons
- Photons (like Lyα) might escape more easily

(ratio of ionizing to non-ionizing photons)



Tang+18



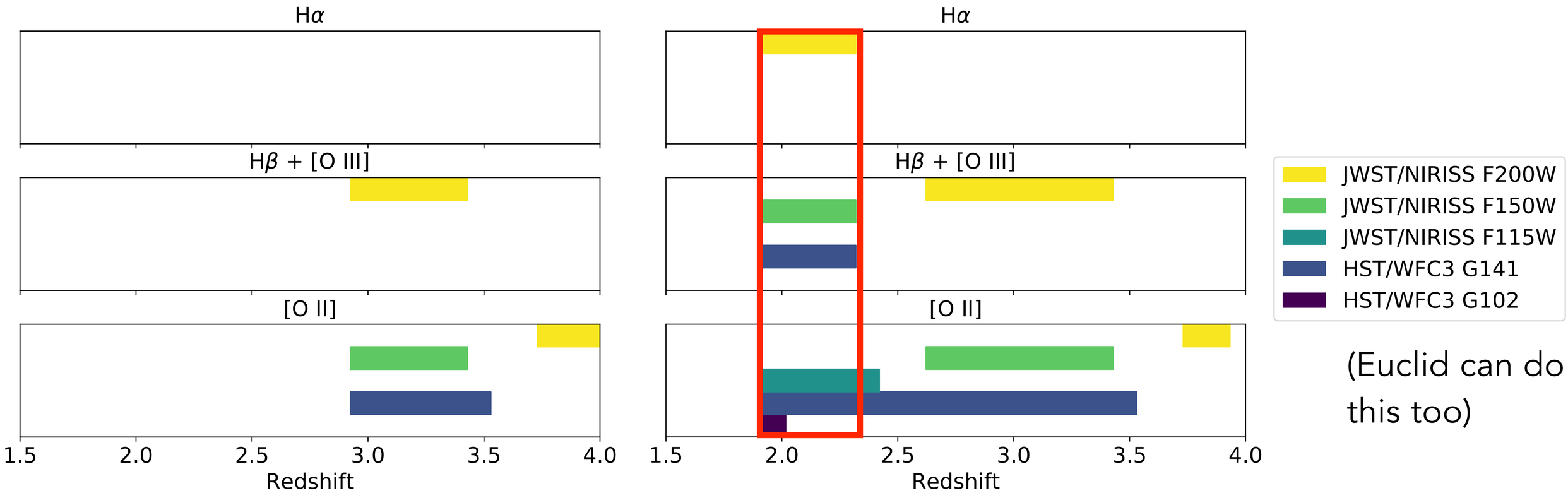
Smith+19

SO WHERE DOES BLUEMUSE FIT IN?

- BlueMUSE will probe Lyα and the rest-UV for z~2 galaxies (the "sweet spot" for slitless grism surveys)

muse multi unit spectroscopic explorer Lyα

blue muse multi unit spectroscopic explorer Lyα



(Euclid can do this too)

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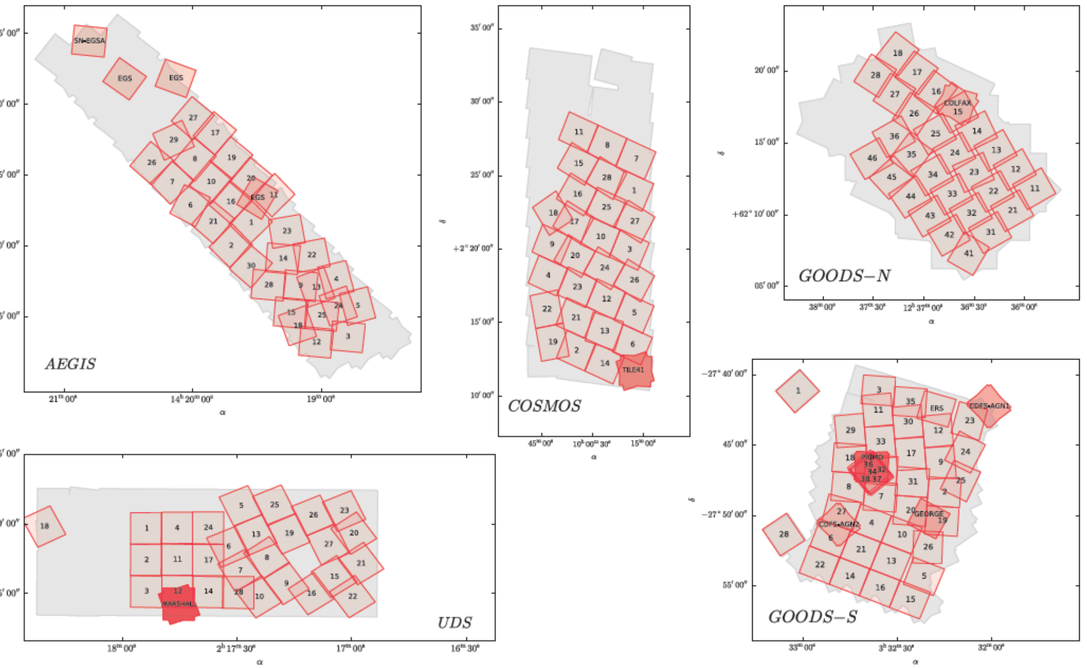
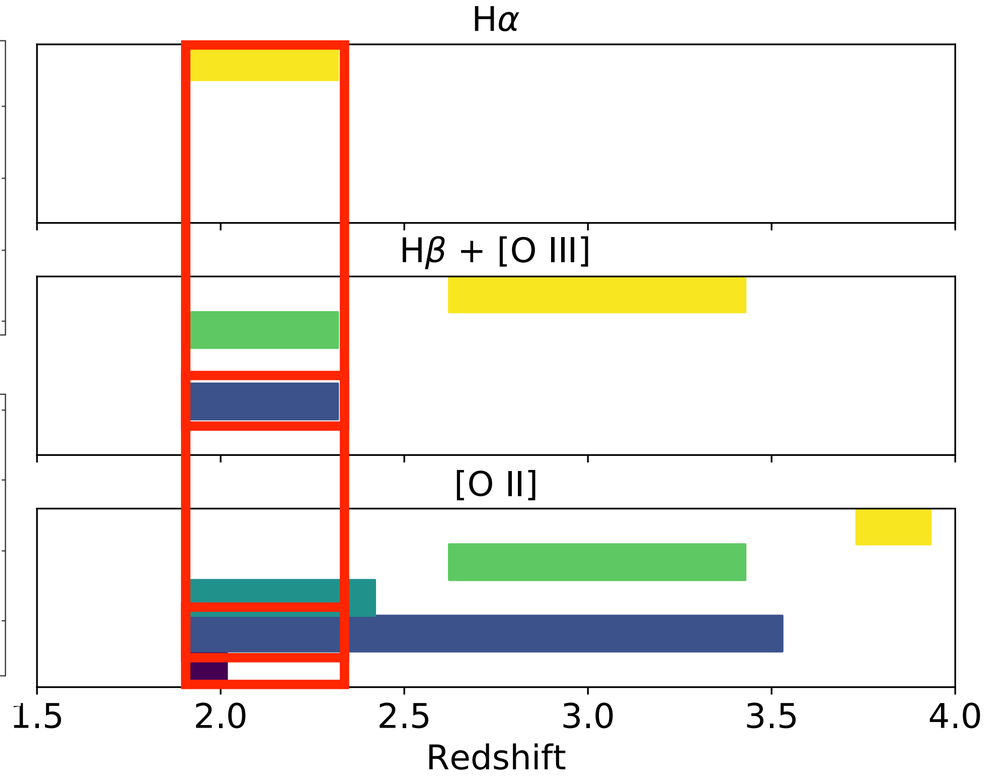
3D-HST: 600 sq. arcmin

(Momcheva+16)



BlueMUSE multi unit spectroscopic explorer Lyα



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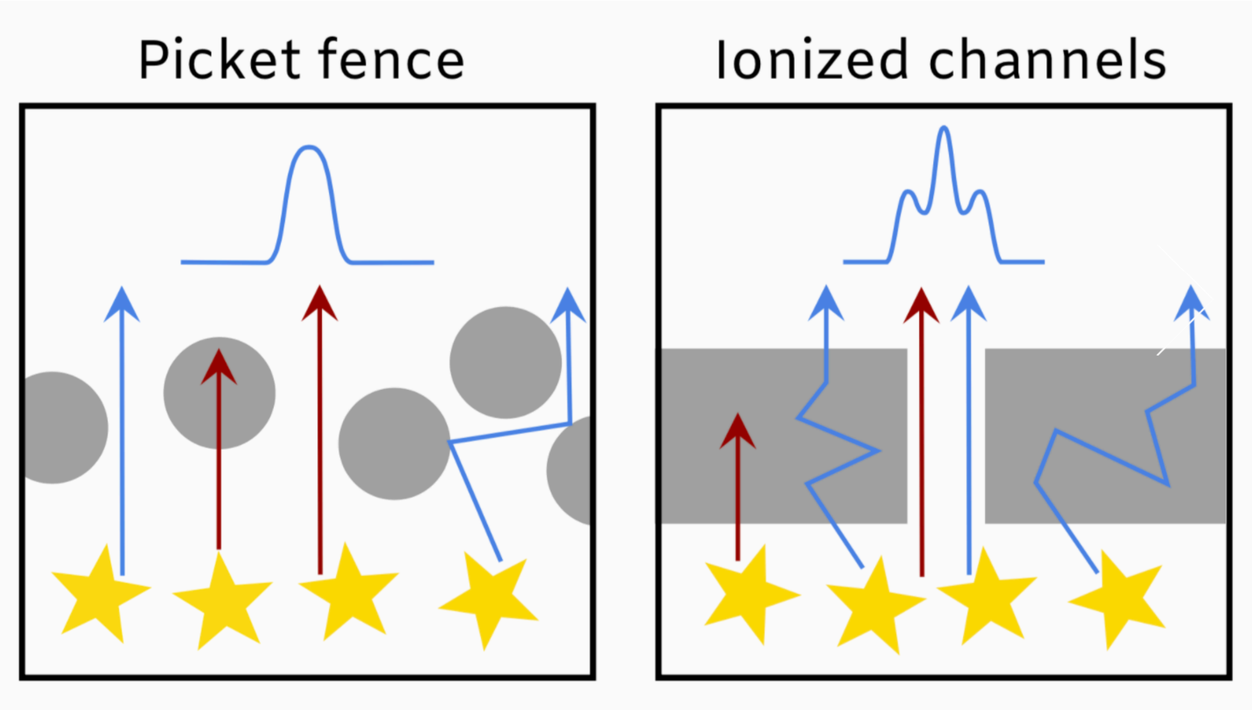
LYMAN-ALPHA ESCAPE

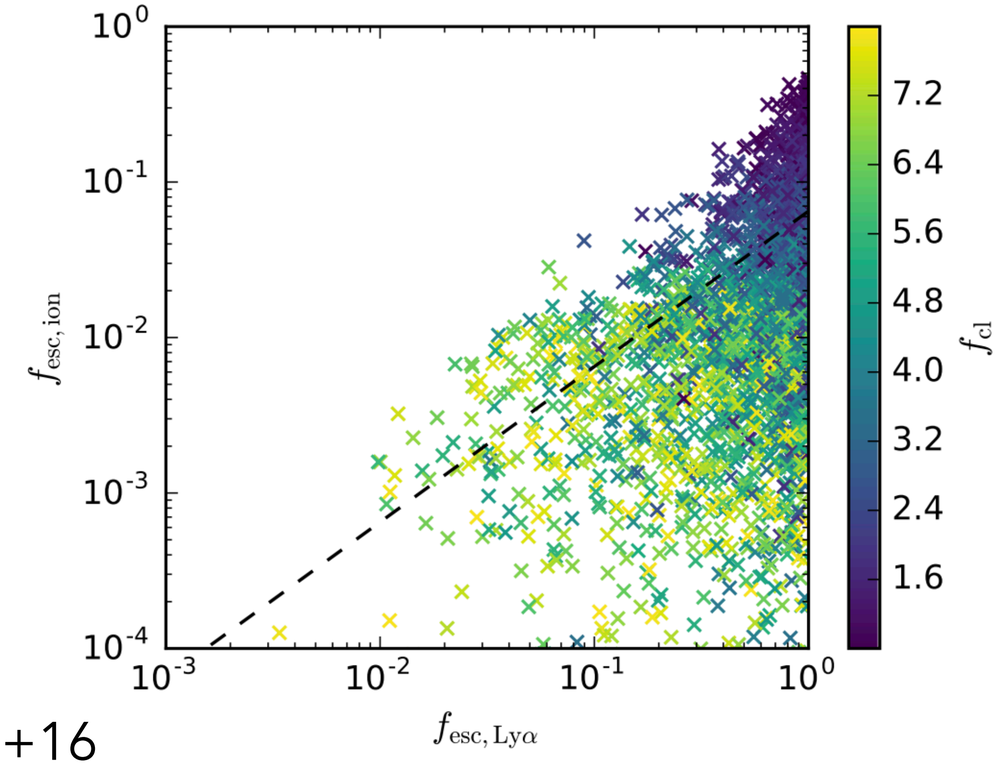
- Lyα photons susceptible to scattering/absorption in the ISM



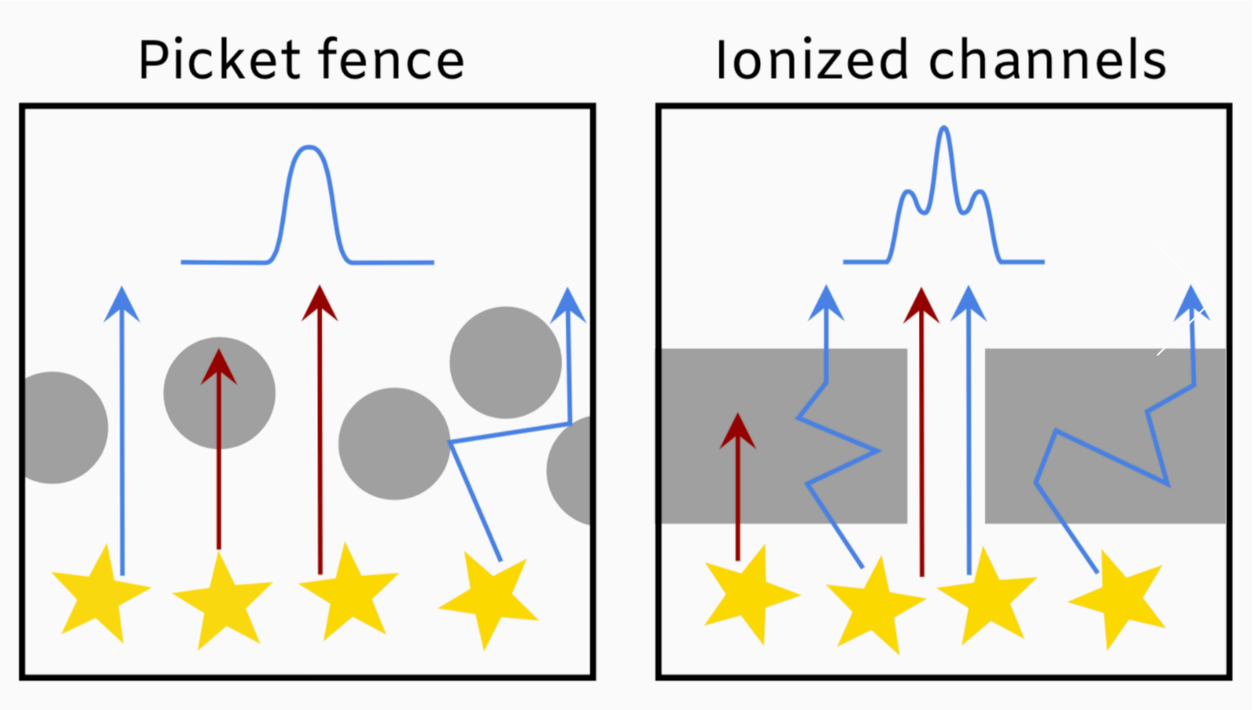
M. Gronke

LYMAN-ALPHA ESCAPE

- Lyα photons susceptible to scattering/absorption in the ISM
- Ratio of production to escape (f_{esc}) is broadly illustrative of ionizing photon escape (f_{ion})



Dijkstra+16

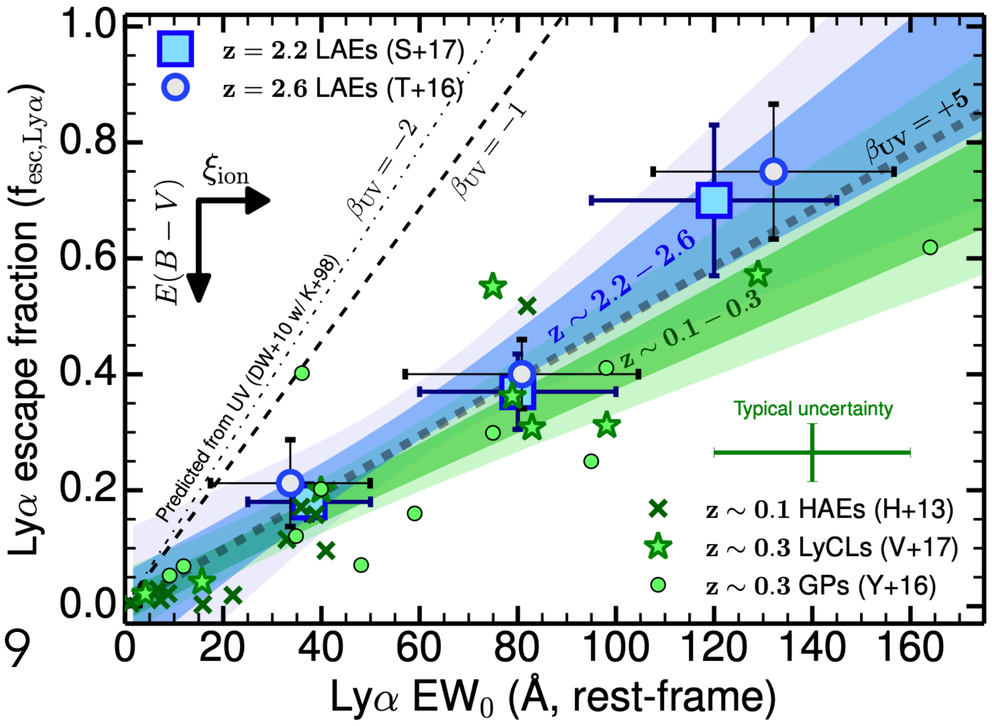


M. Gronke

BOTH CAN BE MEASURED AT Z~2

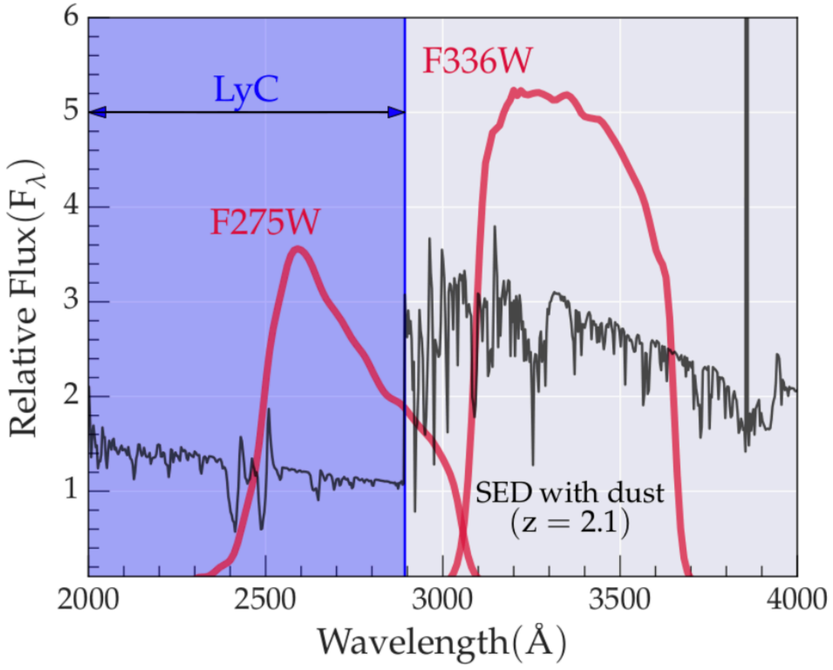
- f_{esc} from ratio of Hα (or Hβ) to Lyα
- f_{ion} from e.g. HST imaging

All for (large) un-targeted samples at 1.9 < z < 2.4



Sobral & Matthee 19

(also Trainor+16)



Naidu+17

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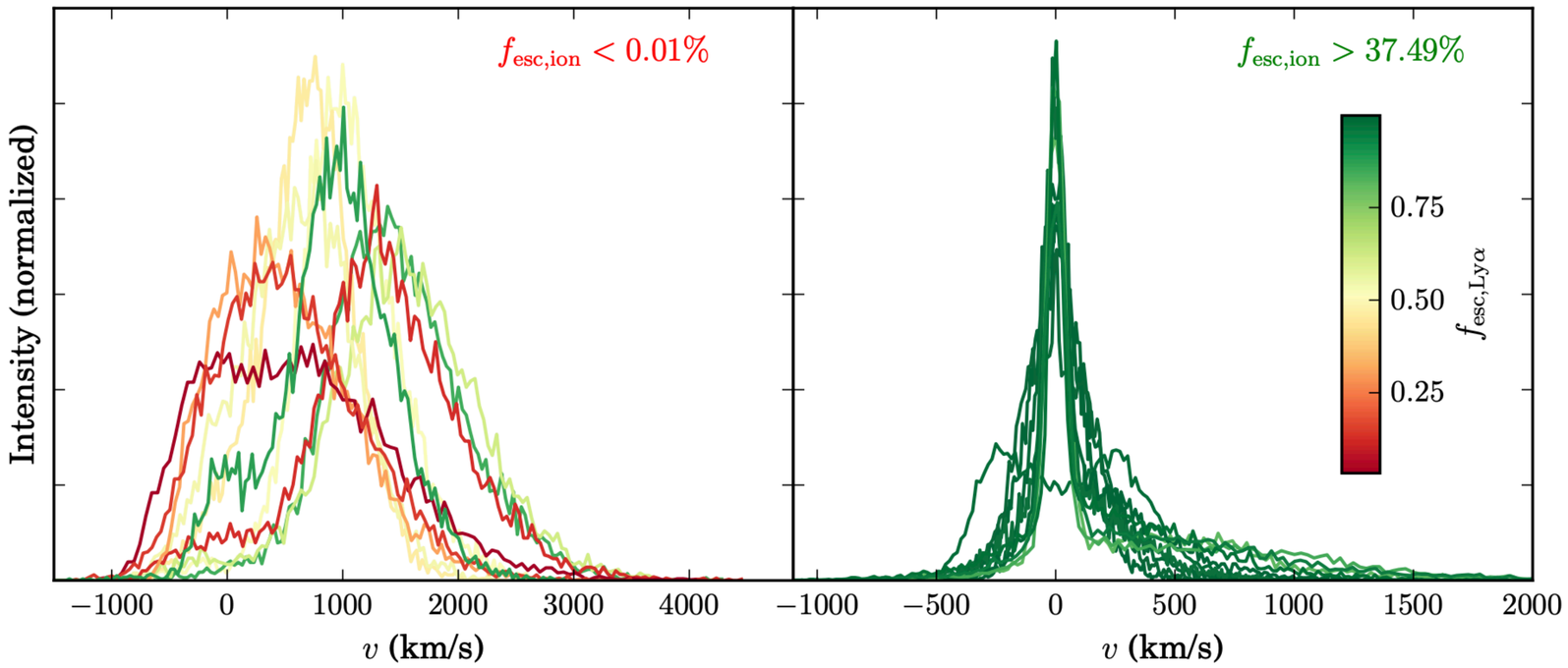
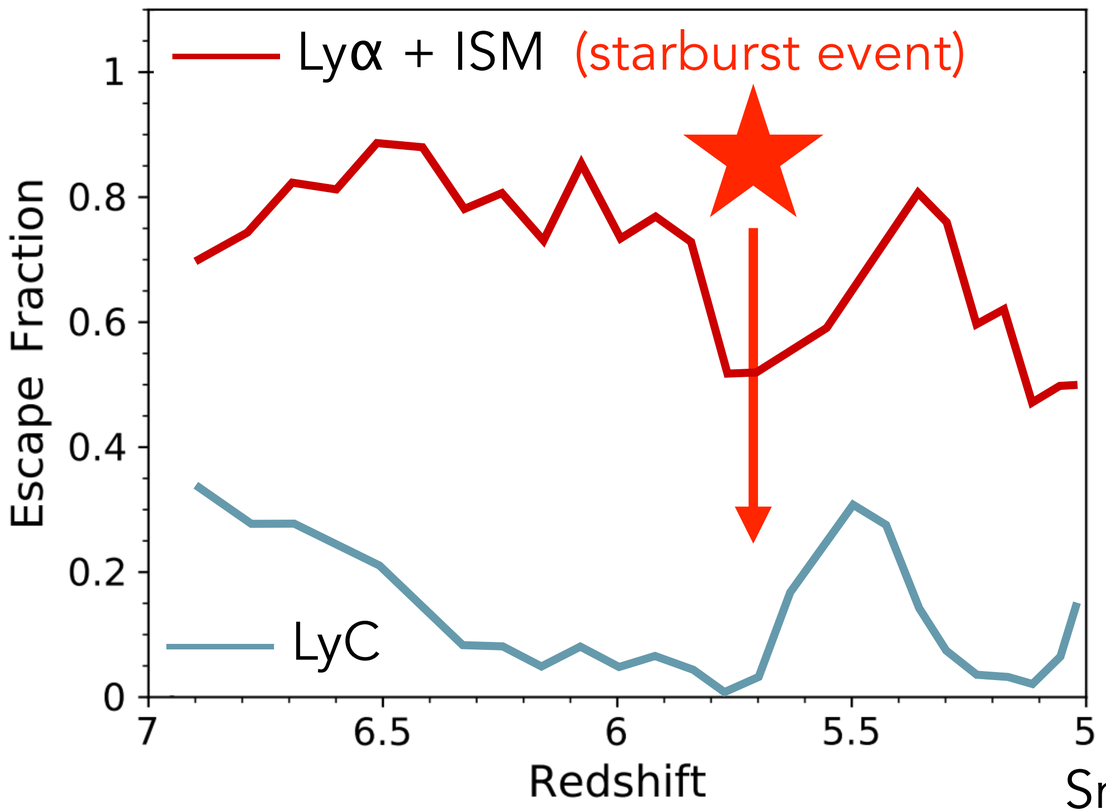


Dijkstra+17

BOTH CAN BE MEASURED AT Z~2; SOMETHING WE CANNOT DO AT Z > 6

- f_{esc} from ratio of Hα (or Hβ) to Lyα
- f_{ion} from e.g. HST imaging (or the Lyα spectral profile from BlueMUSE - see Anne's talk)
- Can we understand how these quantities evolve with time?



Smith+19

WRAPPING UP

- Intermediate-z “dwarf” galaxies uniquely allow for a deeper understanding of galaxies in the early Universe
- Connecting Lyα, the rest-UV, and the rest-optical via BlueMUSE and HST/JWST slitless grism spectroscopy will be a key advance

- BlueMUSE will be a lot of fun!