VUDS | VIMOS Ultra Deep Survey

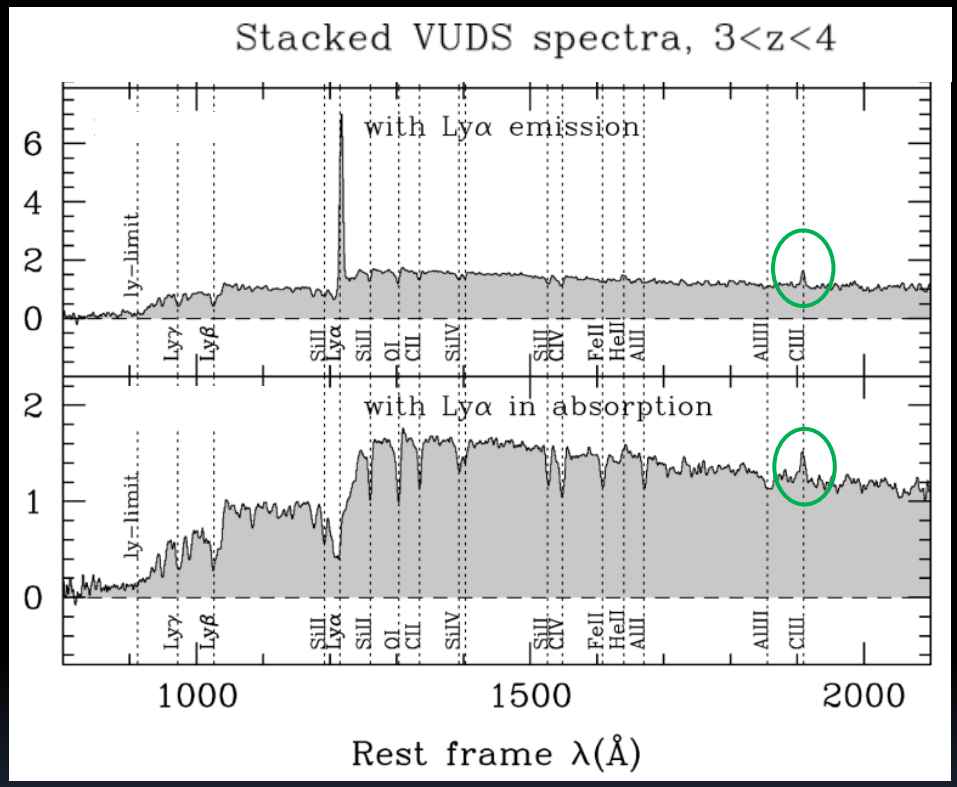
Olivier Le Fèvre
Laboratoire d'Astrophysique de Marseille, France

CIII] EMITTERS AT Z~3: STATISTICS AND EVIDENCE FOR AGN QUENCHING

Why CIII] ?

- There is a lack of spectral features in the UV rest-frame 900-2800Å
  - Lyα-1215Å is a resonant line, ~unreliable
- Redshift measurement is critical (particularly at z>6)
- Estimates of the systemic redshift
  - measure outflows

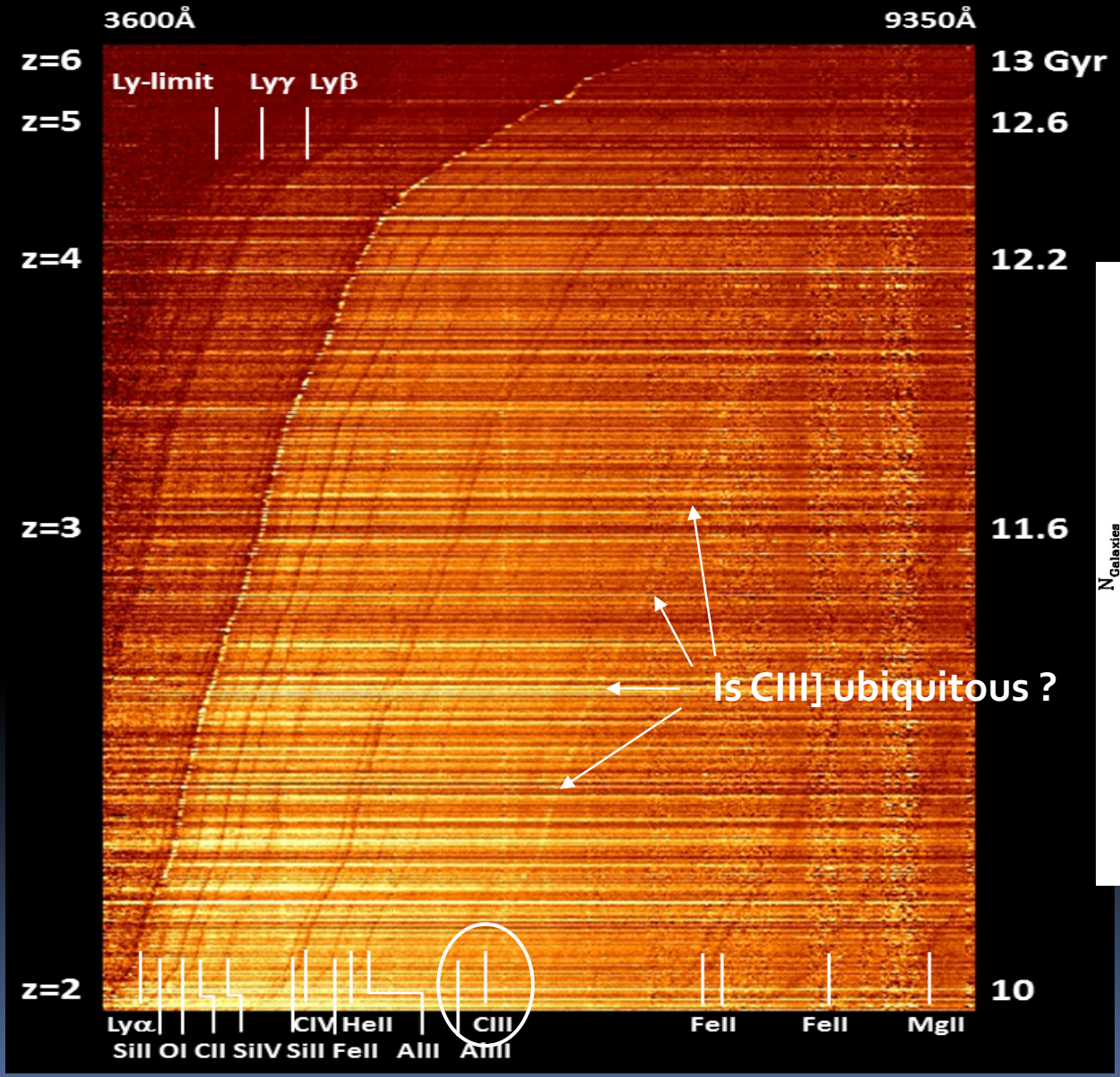
- The CIII] doublet 1907-1909Å is the most frequent emission line besides Lyα
- Ionization potential 24eV
- Can be ionized by hot star in star-forming galaxies, or by AGN
- By its nature, it is present whether Lyα is in emission or not



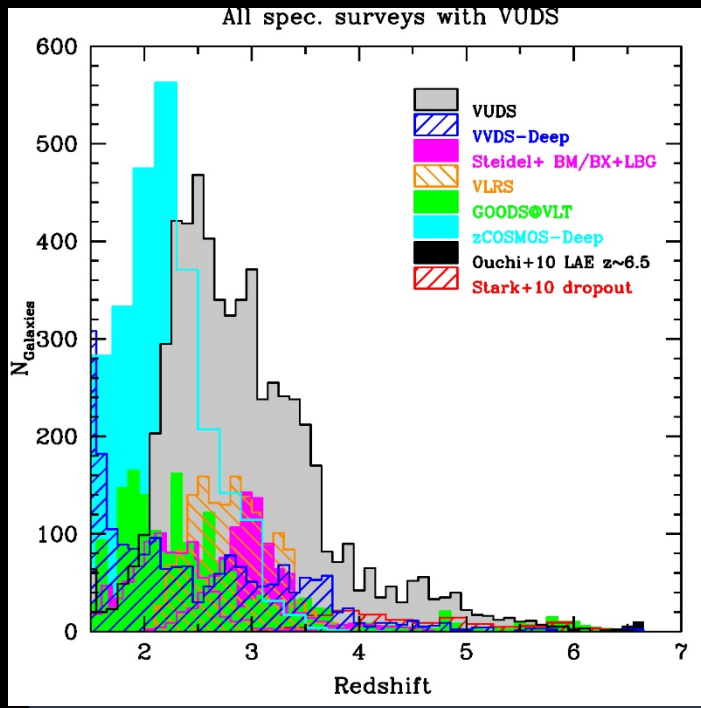
The hope is that CIII] is both a redshift helper and a diagnostic tool

- How frequent is it ?
- Properties of CIII] emitters ?

VUDS a large sample of ~7000 galaxy spectra
2<z<6.5 representation of the SFG population

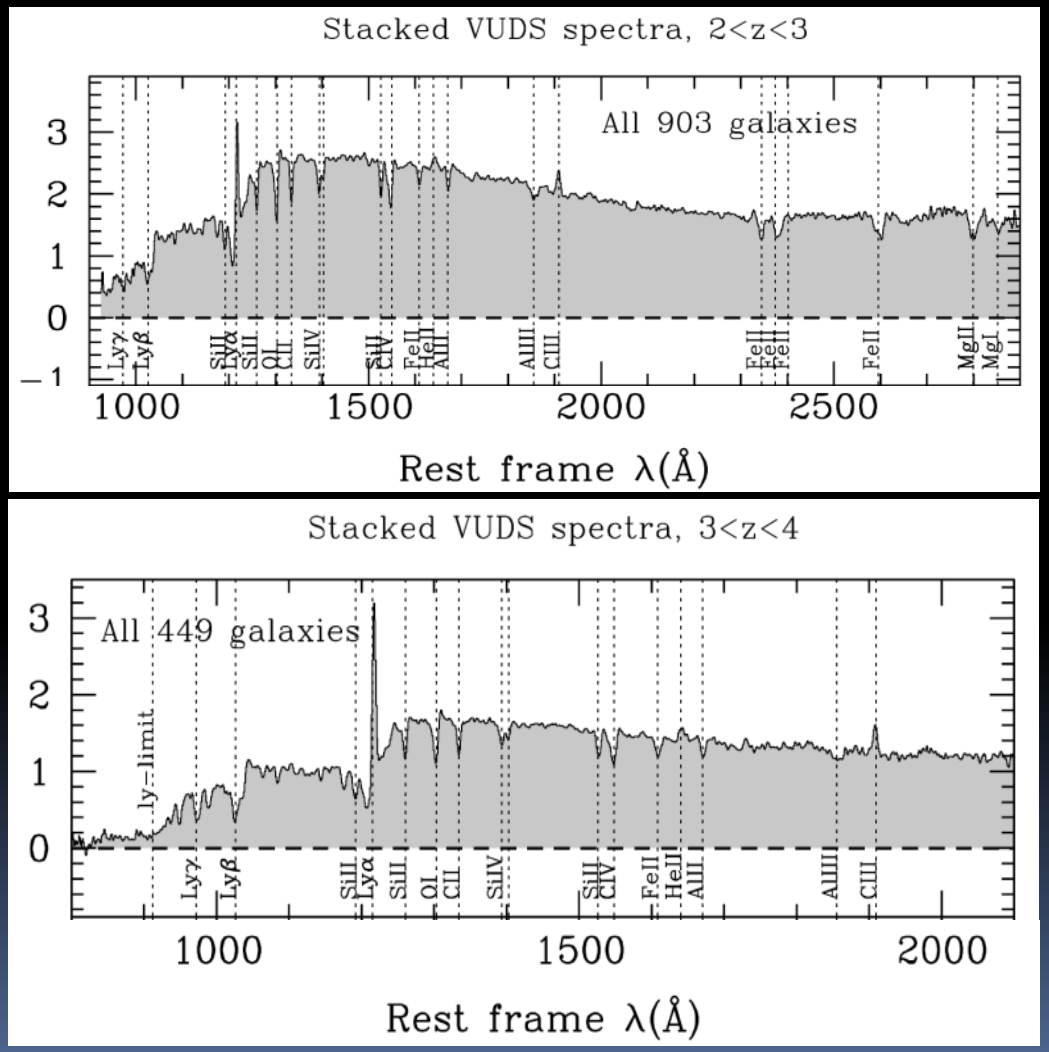


The largest sample of UV-rest selected star-forming galaxies with spectroscopy in 2<z<6.5



VUDS | VIMOS Ultra Deep Survey

Median CIII] emission in the star-forming galaxy population 2<z<3.8



VUDS 2<z<3.8:

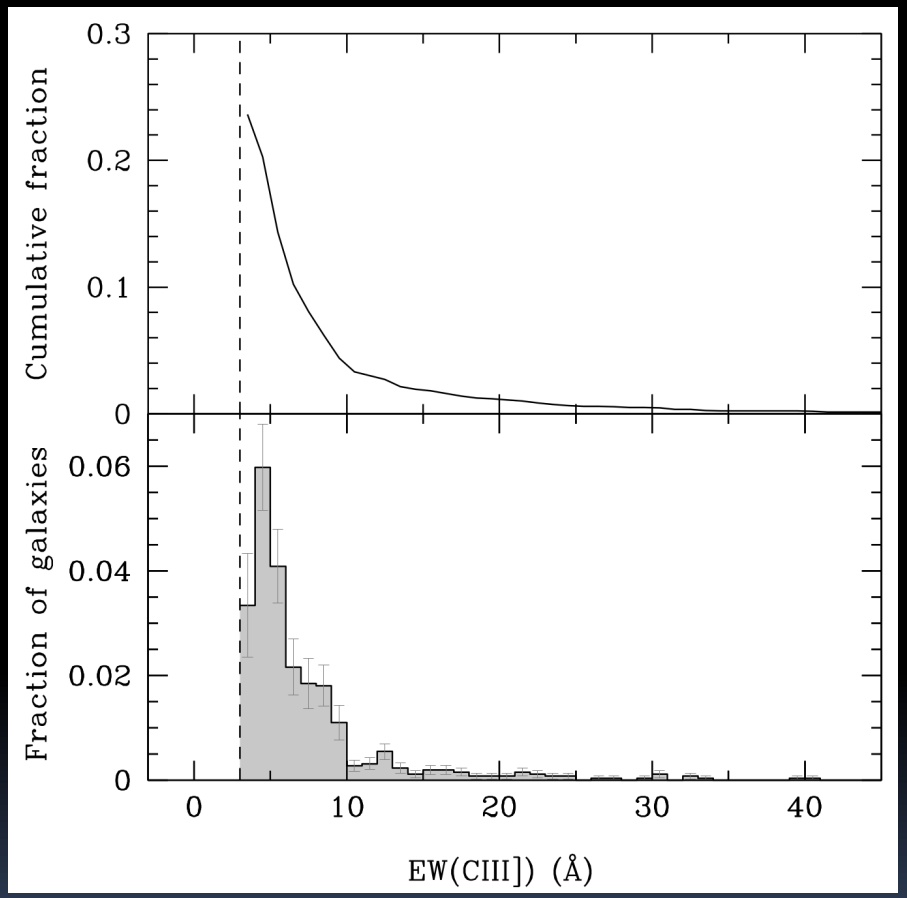
EW(CIII])=2.2Å

Shapley+03: EW(CIII])=1.7Å

Using positive EW as emission

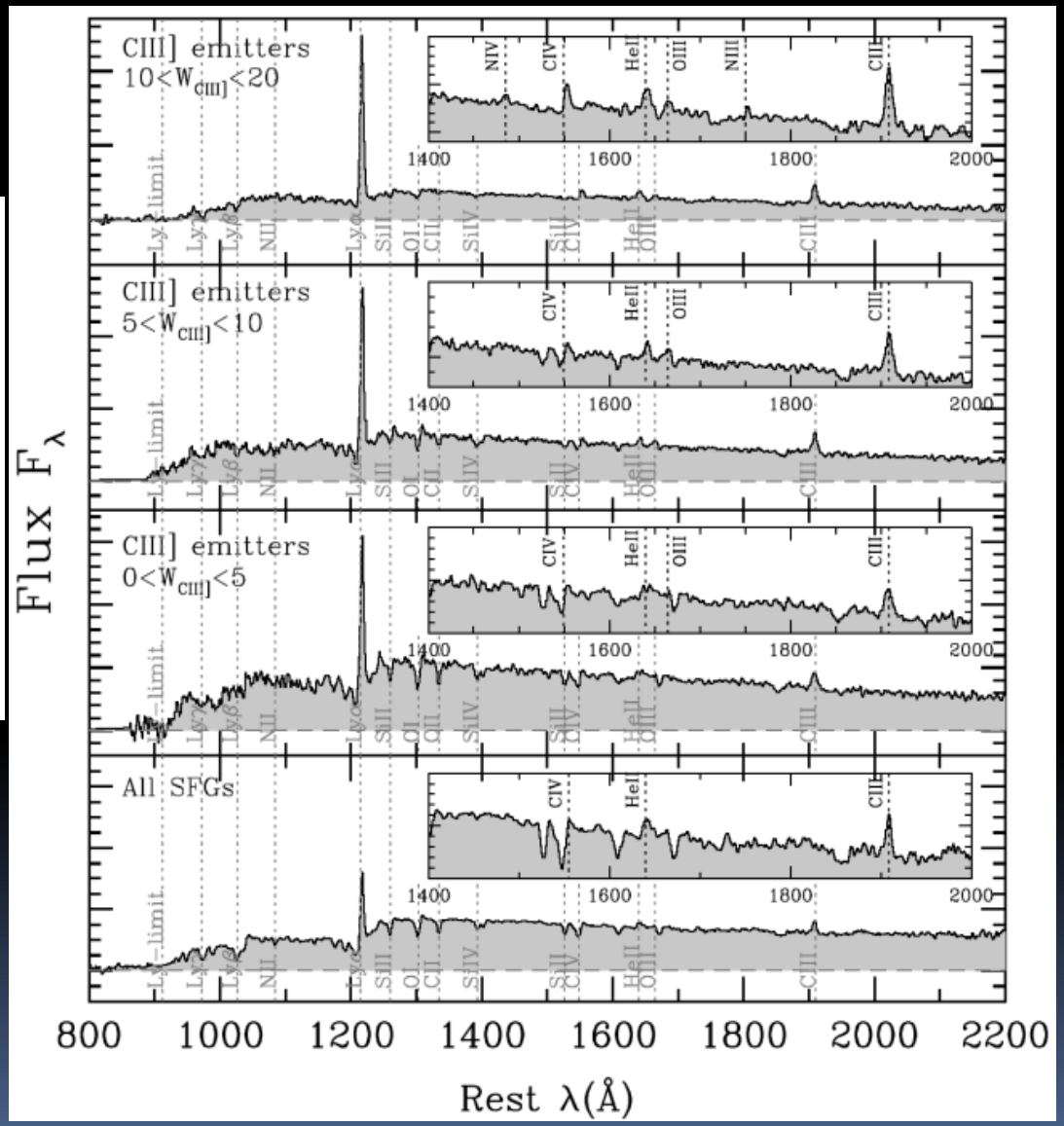
How frequent is CIII] emission ?

- Use sample of 3899 galaxies with 2<z<3.8
- Measure EW(CIII]) and local noise
- Reliable for EW(CIII])>3Å
- Use false detections with EW(CIII])<3Å to correct the distribution
- Result: **24% of the SFG population emits CIII]>3Å**
- CIII] is frequent but CIII] emission at a level accessible to the deepest spectra mises 3/4 of galaxies
  - Cannot be used alone to find out high-z >6 redshifts



Le Fèvre et al., in prep

Specific populations: CIII]-1909A emitters 2<z<3.8



Increasing EW(CIII])

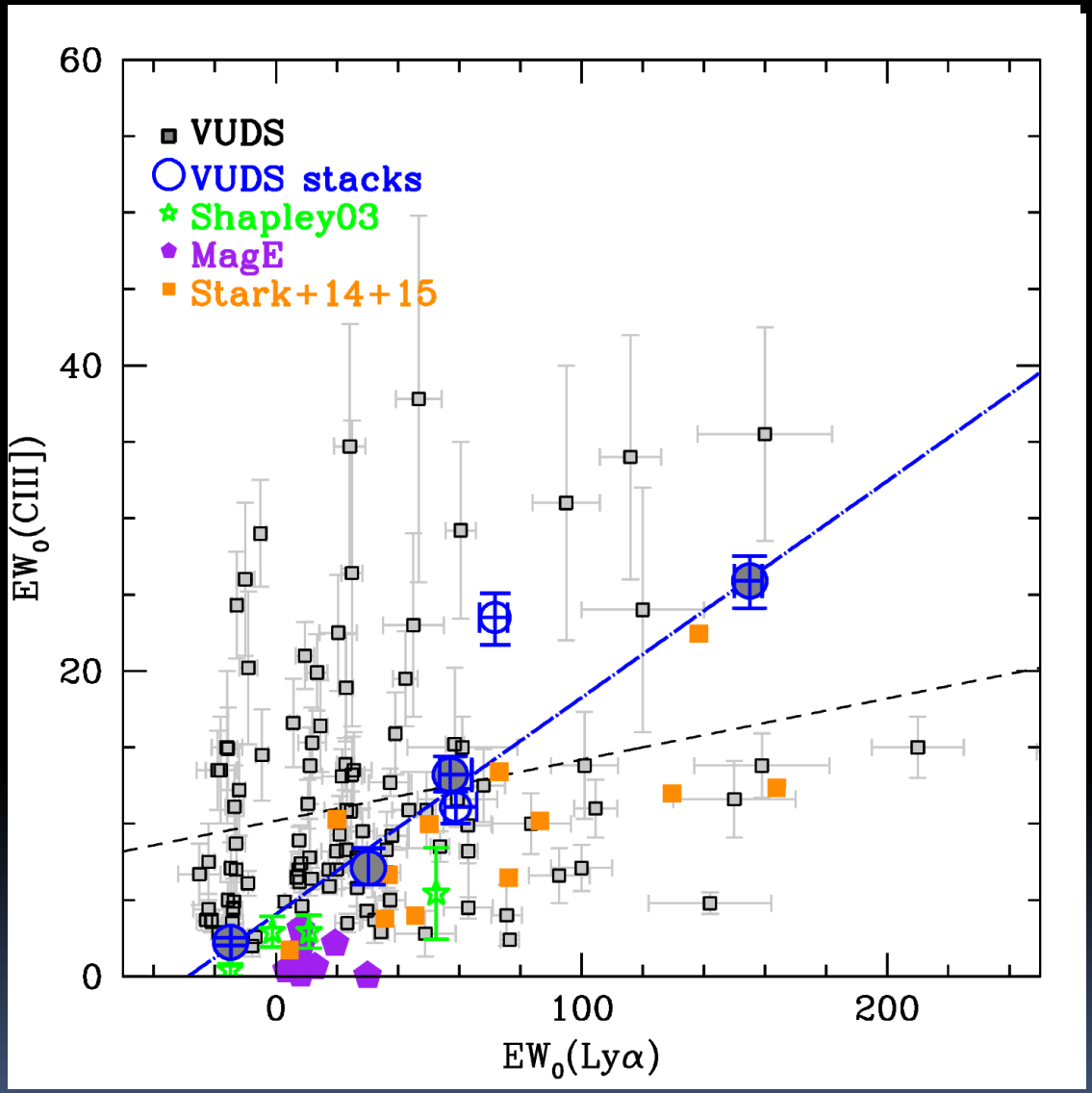
Stacks of CIII] emitters identify a wealth of other nebular emission lines: OIII, CIII, CIV, NIII, NIV, NV

Studying the population of strong CIII] emitters is possible only if a large volume is explored (VUDS)

Le Fèvre et al. in prep.

See study of 10 low metals VUDS galaxies in Amorin+17

CIII] vs. Lyα

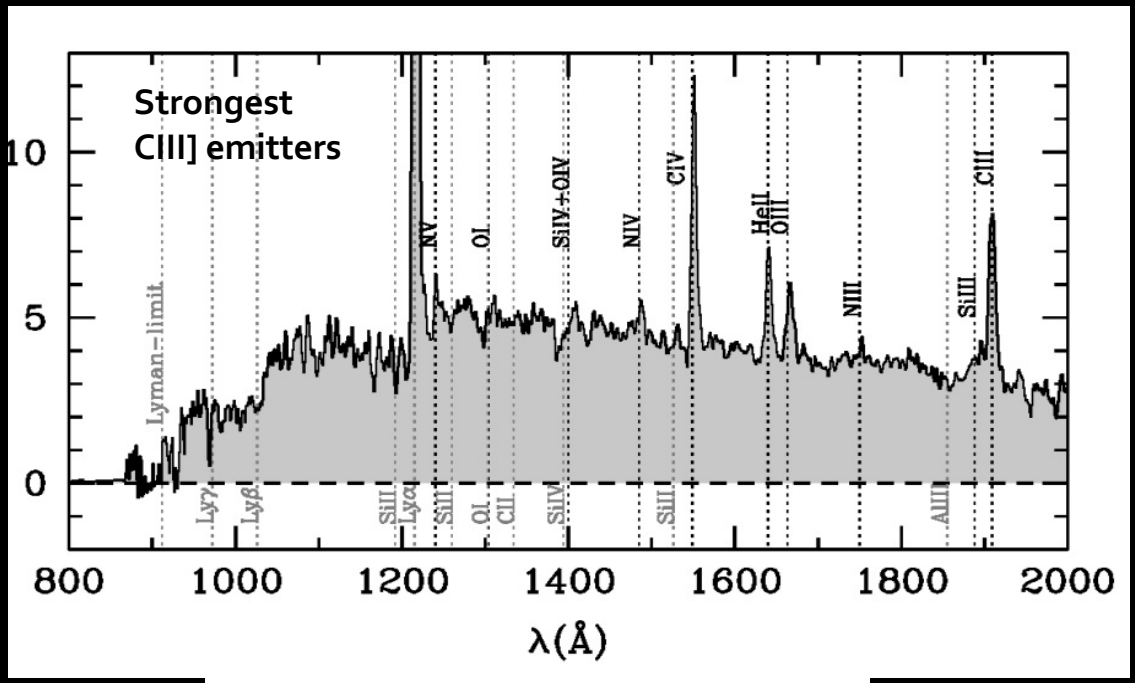


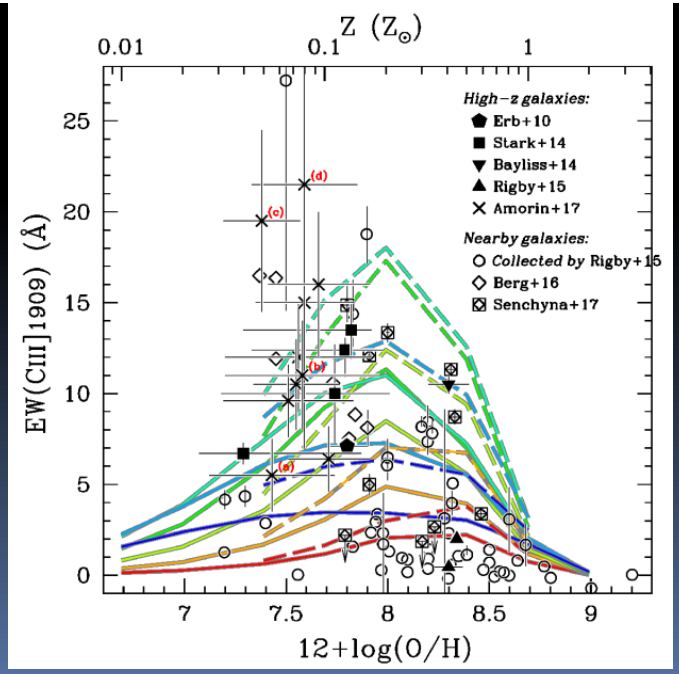
Nice correlation ?

But large dispersion: There are strong CIII] emitters without Lyα, and vice-versa

Strongest CIII] emitters in the SFG population at z~3

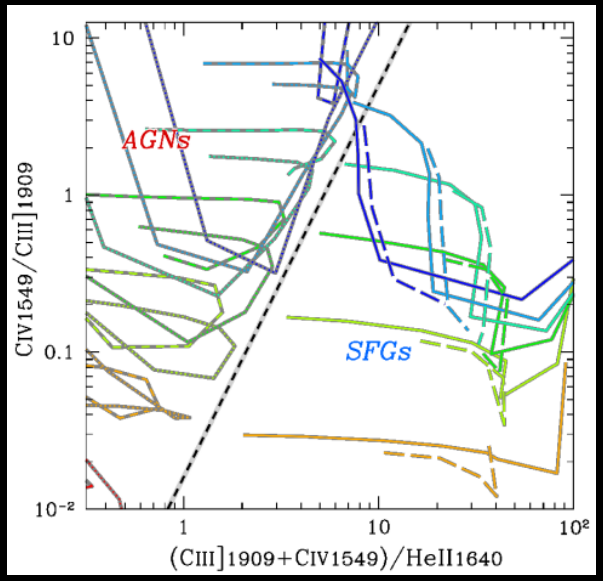
- Producing large EW(CIII])>20Å requires a powerful ionizing source
- Fraction of emitters with EW(CIII)>20Å f(CIII])≈2.4%
- What is producing the ionizing spectrum ?



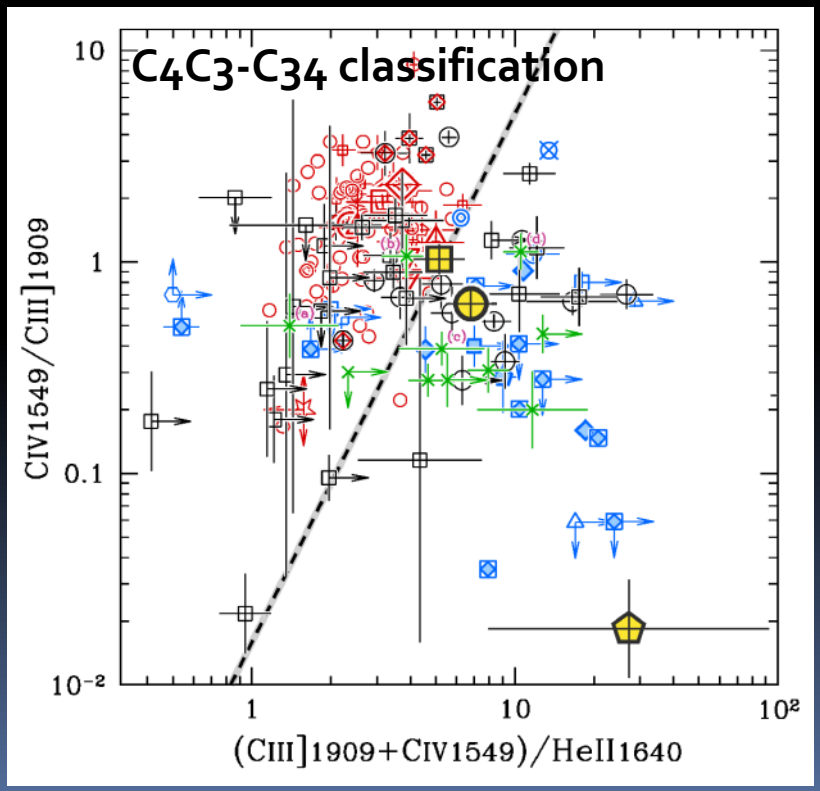


Nakajima+17

Ionizing field producing CIII] at z~3: stars or AGN ?



Cloudy models



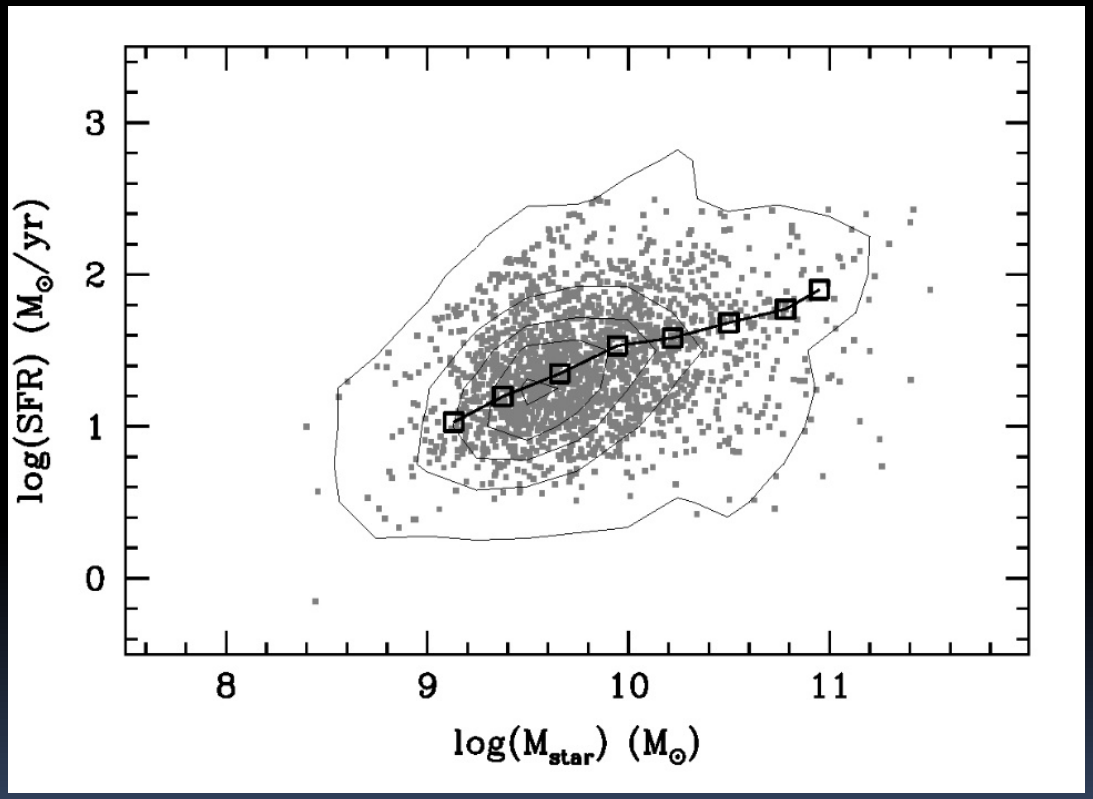
- Classification diagrams using UV nebular lines
  - Expands into the UV the classical BPT in optical
- Photoionization models with *Cloudy* using different sources: Young stellar populations, AGN, blackbody, …
- Classification shows that 1/3 of the strongest CIII] emitters are powered by AGN

Nakajima et al., arXiv:1709.03990

Black symbols: VUDS CIII] emitters
Black-yellow: VUDS CIII] stacks
Other symbols: calibration on known sources

CIII] emitters on the Main Sequence?

What is the location of CIII] emitters of increasing strength on the MS ?

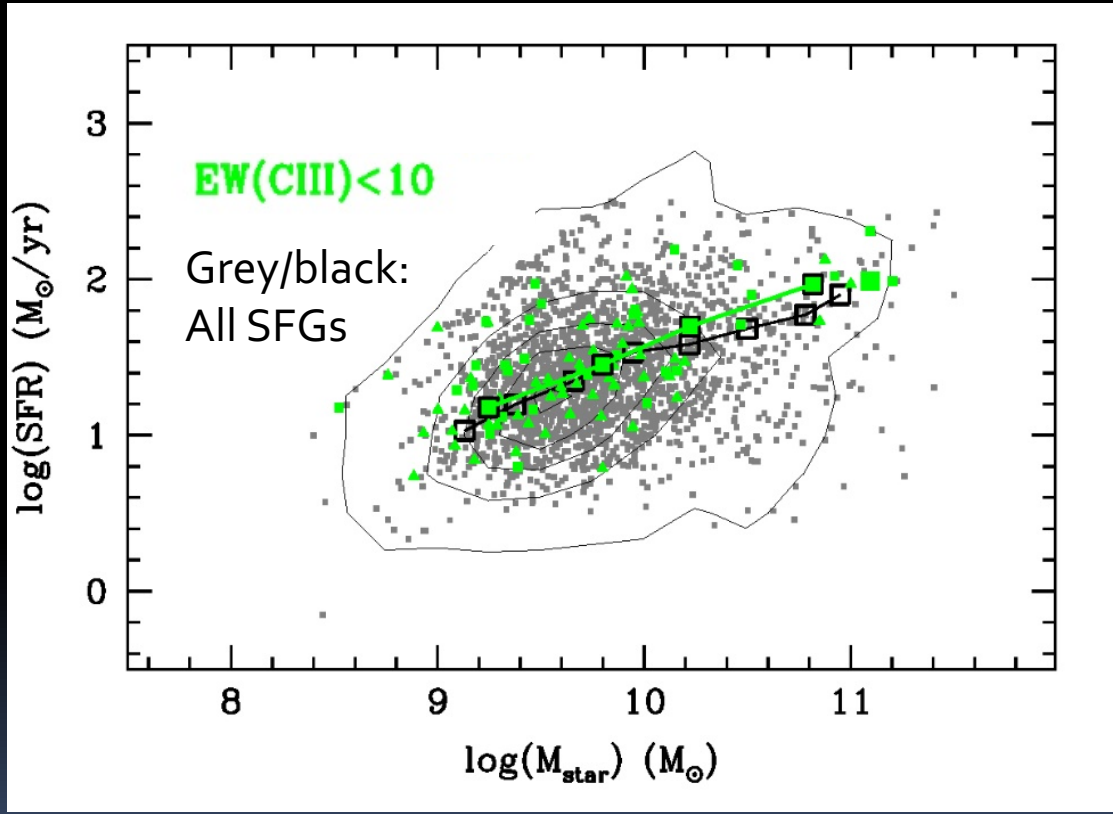


CIII] emitters on the Main Sequence

Weak to moderate emitters EW(CIII])<10Å

…

are located on the MS

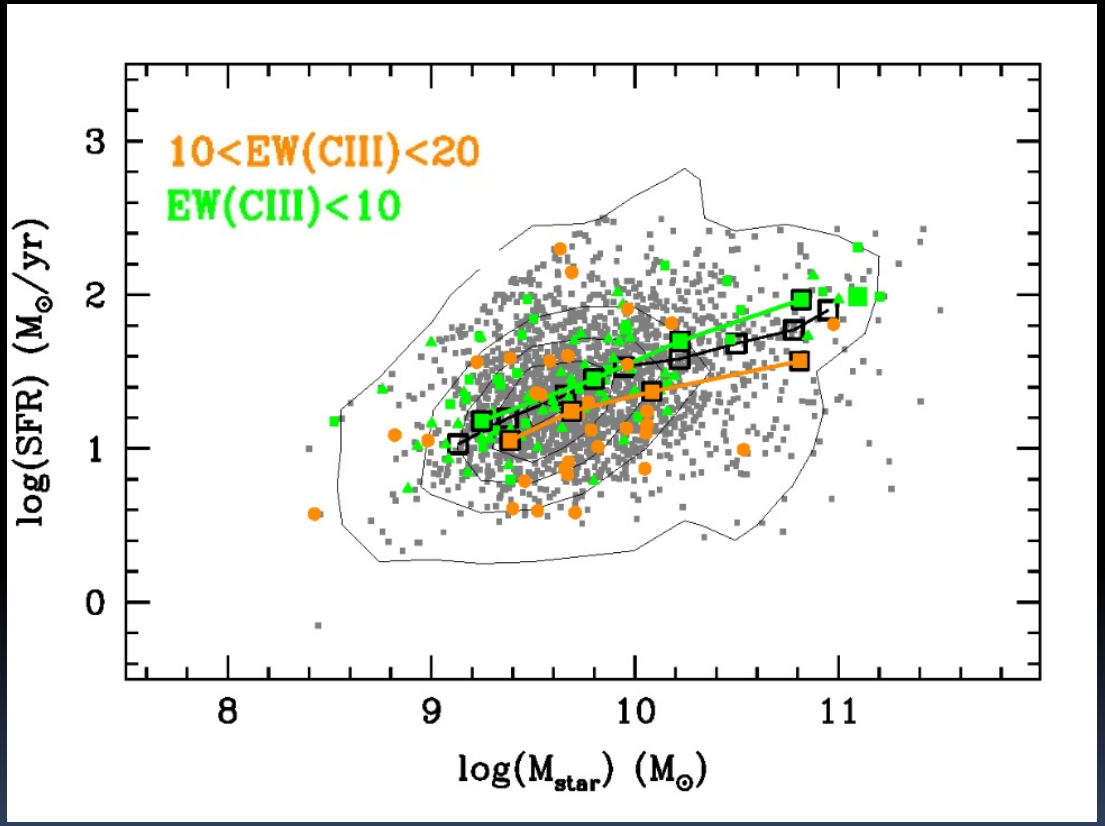


CIII] emitters on the Main Sequence

Strong emitters
10<EW(CIII])<20Å

…

are on average 0.15 dex
below the MS



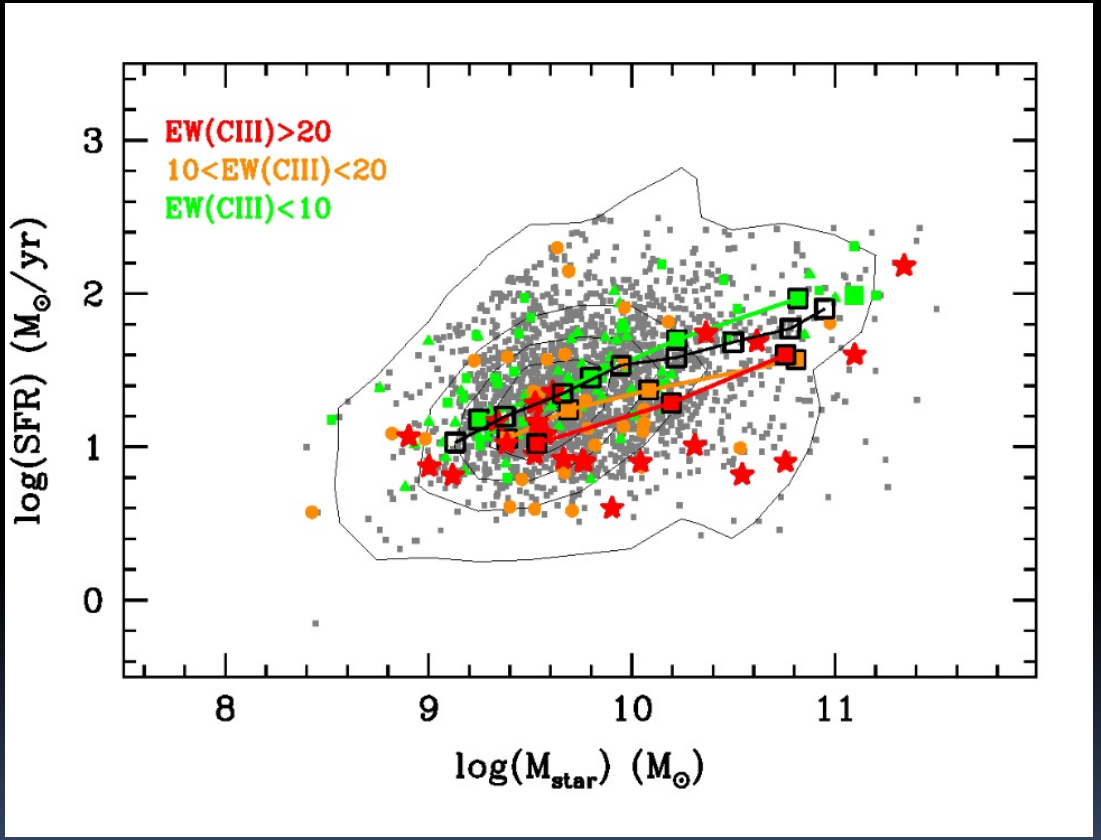
CIII] emitters on the Main Sequence

Strongest emitters EW(CIII])>20Å

…

are on average 0.3dex below the MS

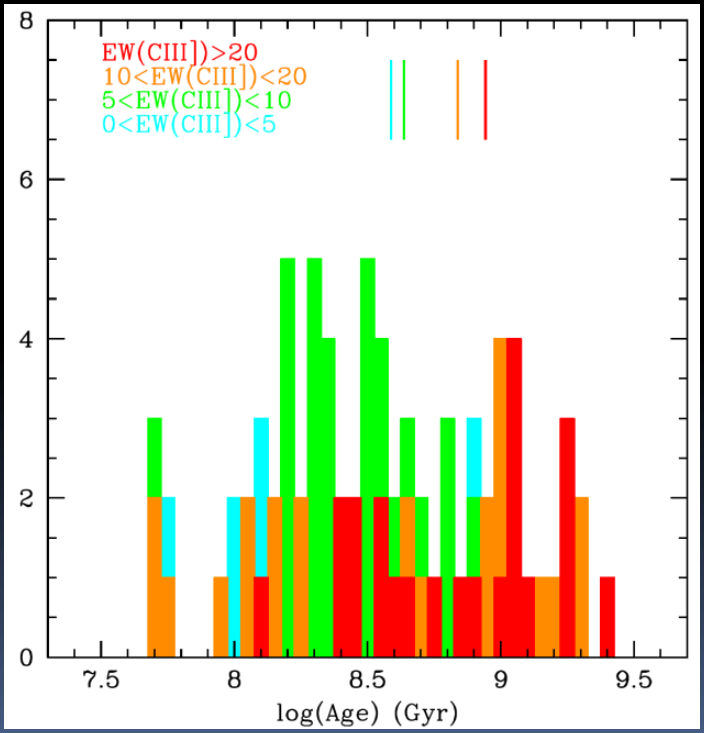
Reduced SFR by ~×2



Age of CIII] emitters

Strongest emitters EW(CIII])>20Å

Are older than weak emitters
~0.9Gyr vs. ~0.4Gyr



- Strong CIII] emitters fall below the MS
- A fraction of these emitters are shown to host AGN from photoionization classification diagrams
- The strongest emitters are the oldest (caveat: SED fitting)

A likely explanation is that we are witnessing AGN feedback quenching star formation

This is most evident in the oldest galaxies, for which quenching has had time to act

Summary

- Important to explore spectral diagnostics in the UV
  - To be combined with optical rest-frame (JWST…)
- CIII] is a very useful line, 24% of SFGs have EW(CIII])>3Å
  - But will not replace multi-feature redshift measurement
- Analysis of CIII] emitters with photoionization models shows that 1/3 of the strongest emitters are powered by AGN
- The position of CIII] emitters around the MS shows that the strongest, those with AGN, are below the MS
- We are likely witnessing the effect of AGN feedback, suppressing, "quenching", star formation