Census of Lya, [OIII]5007, Ha, and [CII]158um Line Emission with 1000 LAEs at z=4.9-7.0 Revealed with Subaru/HSC

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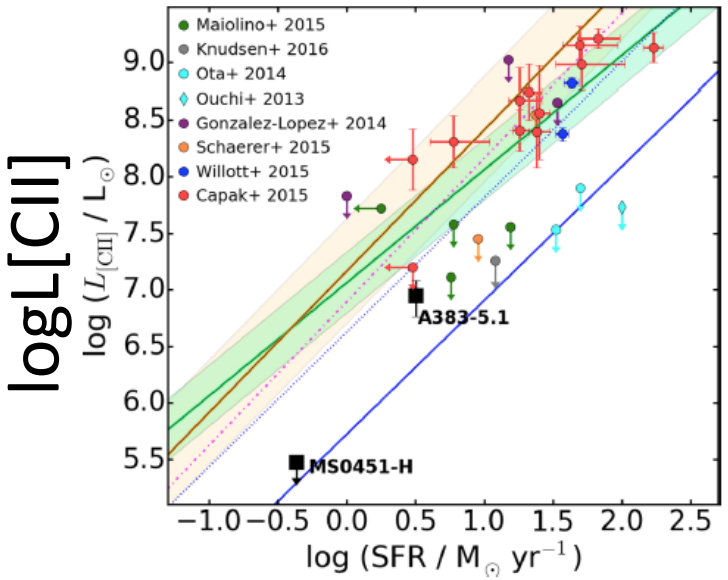
Outline

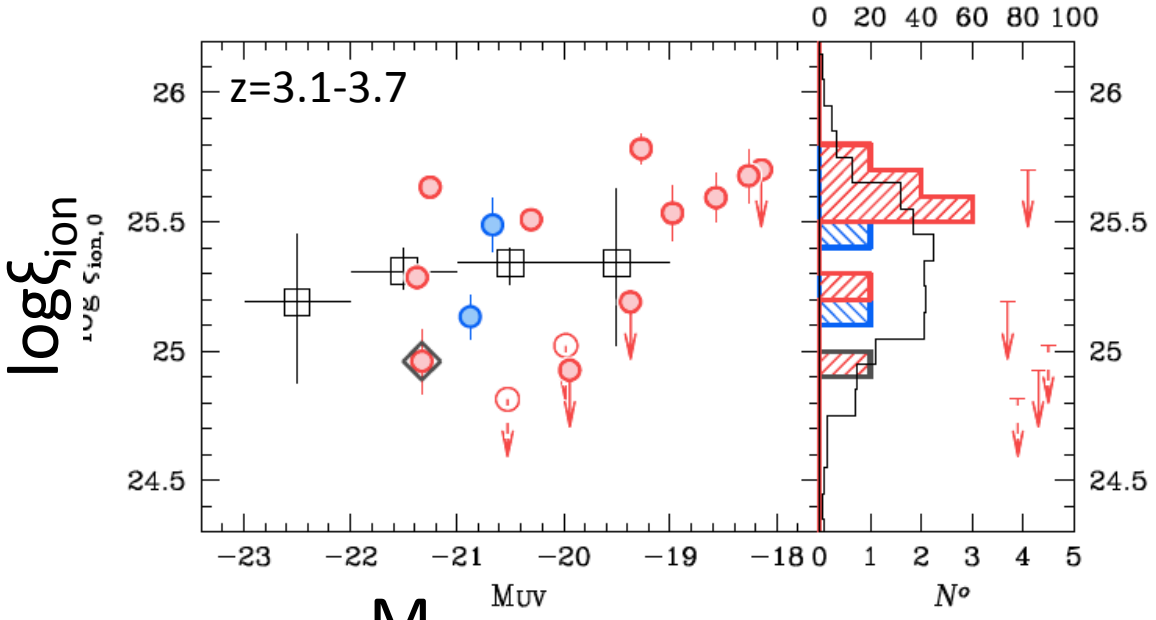
- Introduction
- Sample
- IRAC excess technique
- Results and Discussion

ISM of z>4 LAEs

- Weaker [CII] emission in high-z galaxies
  - What is the origin?
- Reionization by star-forming galaxies (LAEs)?
  - Few measurements of ξ_{ion} for LAEs at z>4



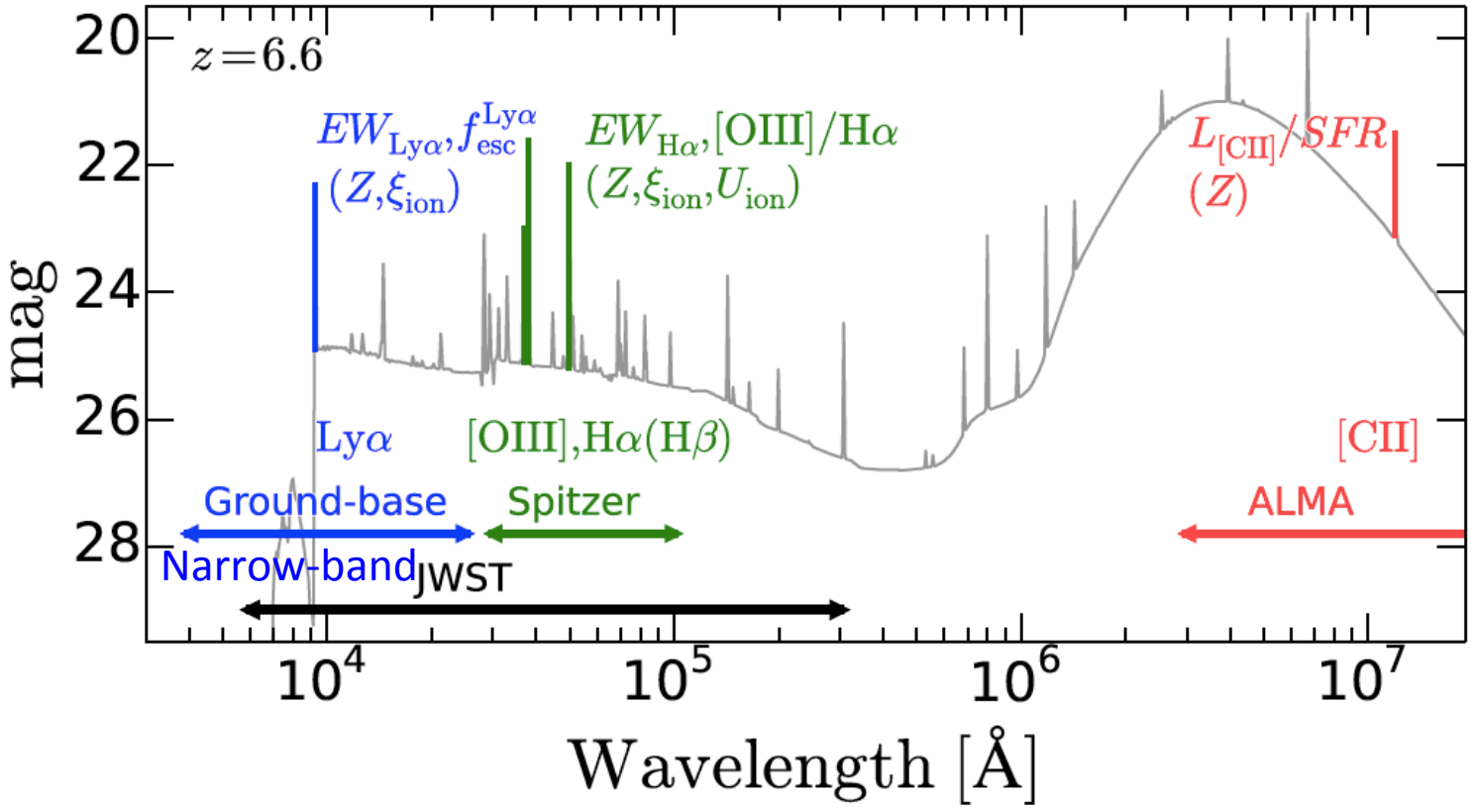
Knudsen+16



Nakajima+16

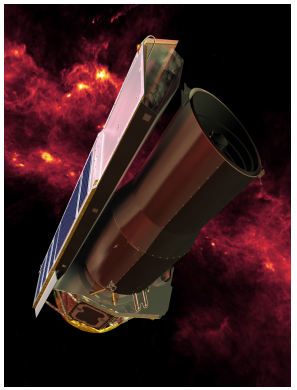
Our Sample: Subaru/HSC

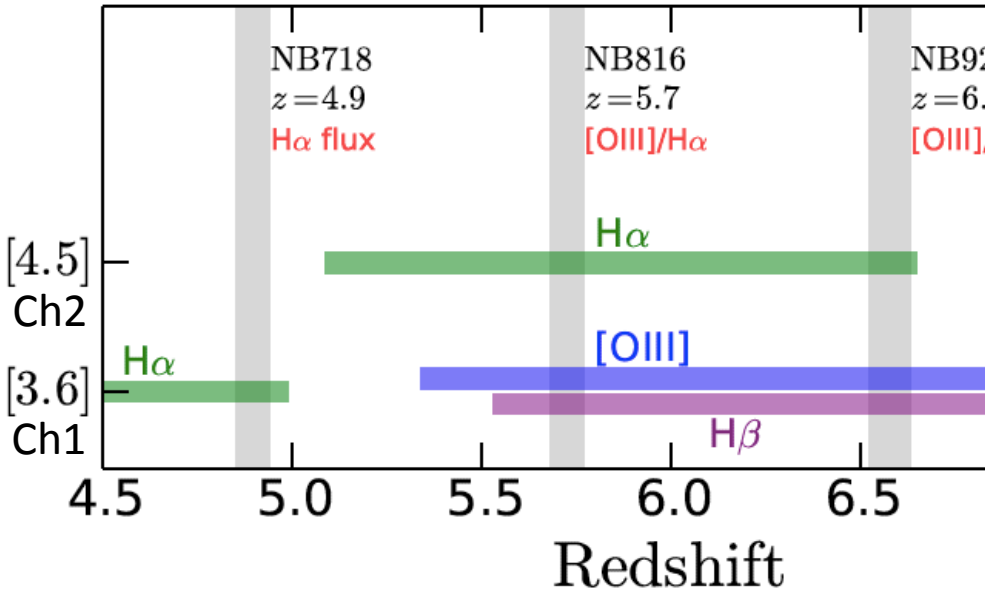
- 1092 LAEs with Spitzer (Shibuya+18, Itoh+, Zheng+ in prep.)
  - NB816, NB921 (HSC-SSP), NB718, NB973 (CHORUS)
- 34 galaxies with ALMA/PdBI [CII] data (literature)

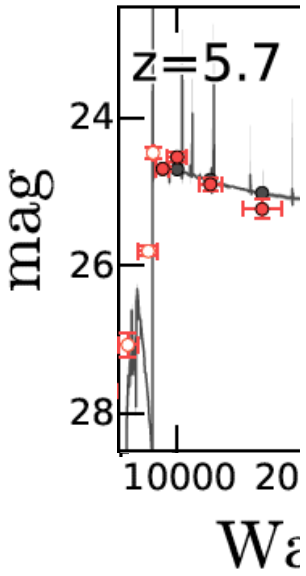


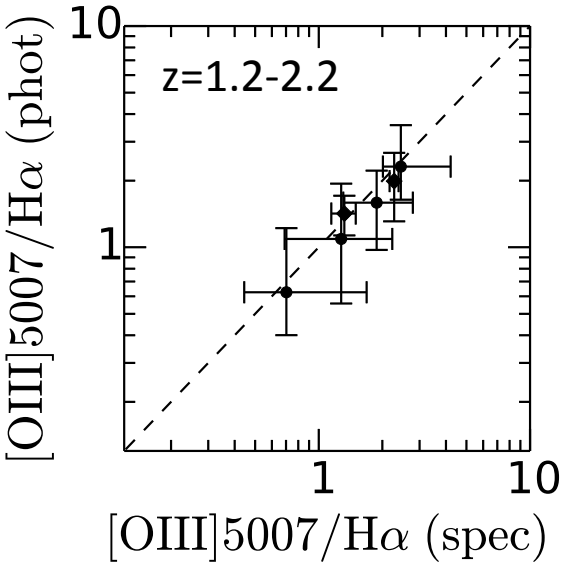
Spitzer/IRAC Excess Technique

- IRAC excess by strong rest-optical emission
  - e.g., Roberts-Borsani+16, Stark+17
- Constraining Ha, [OIII], Hb at z=4.9-7.0
  - SPLASH data (PI: P. Capak)



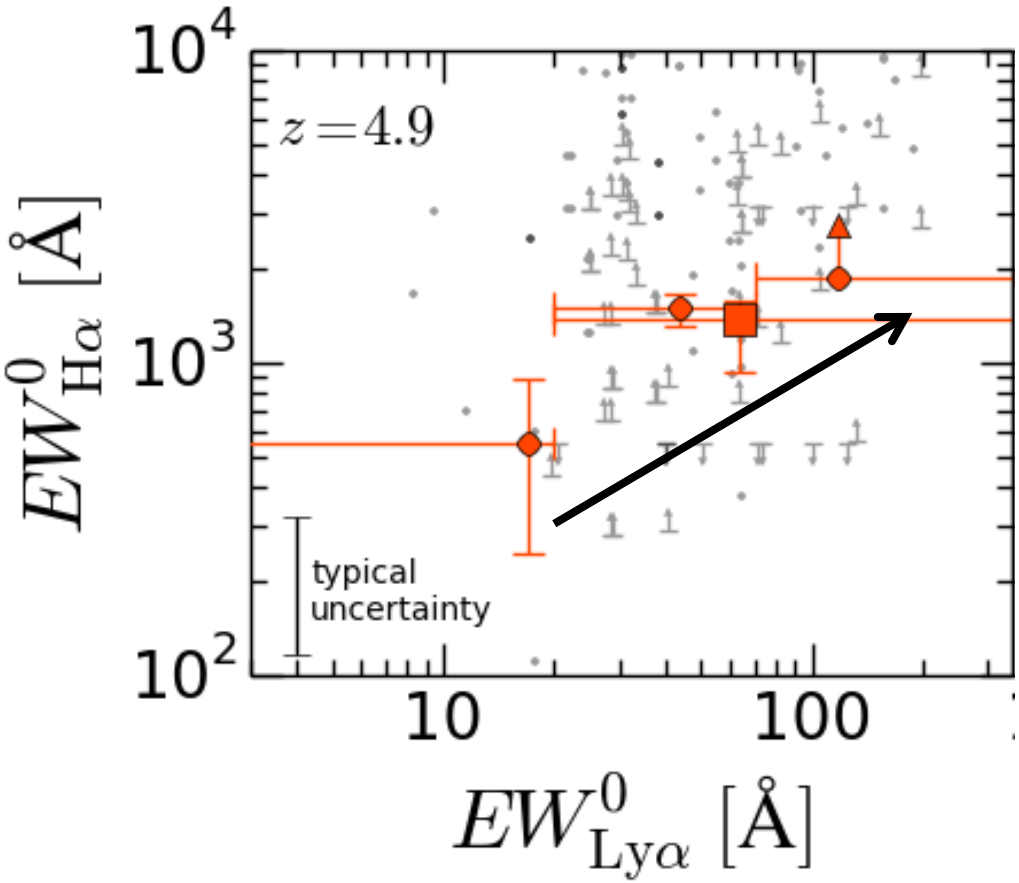






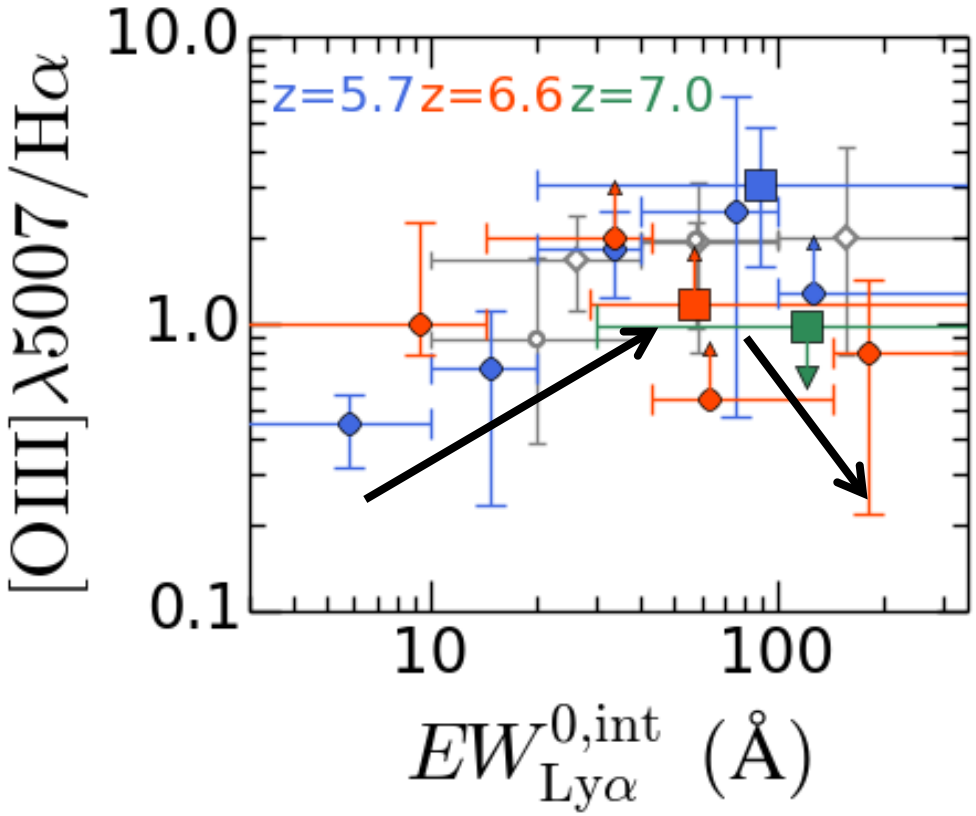
Result 1: Ha EW

- Ha EW positively correlates with Lya EW
  - EW_{Ha}>2000 A with EW_{Lya}~100 A



Result 2: [OIII]/Ha

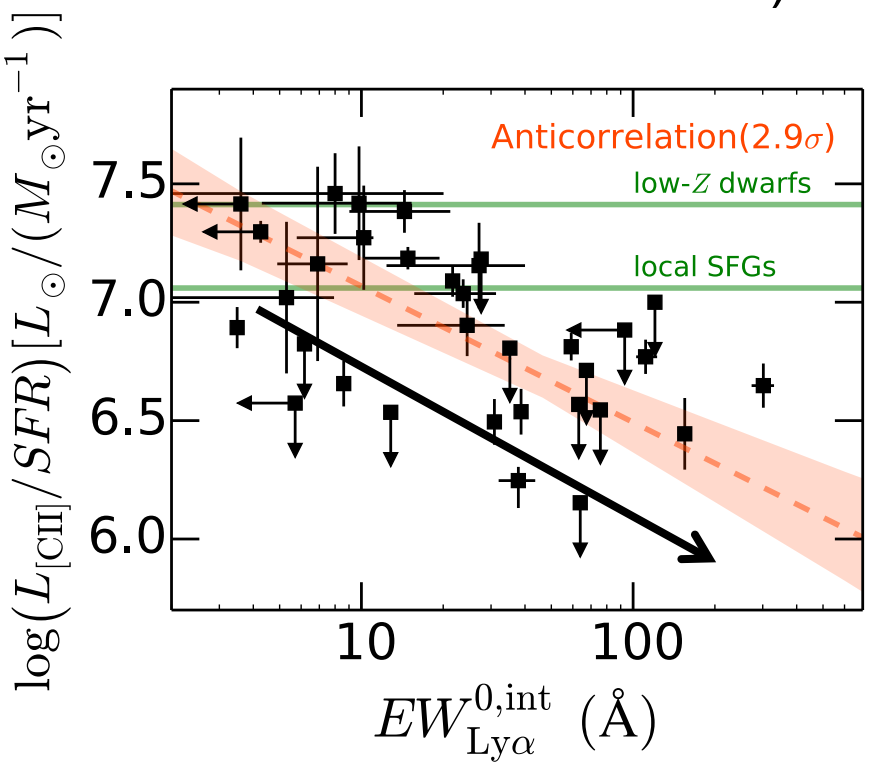
- Turn-over trend in [OIII]/Ha-EW_{Lya} plane
  - Indicating low-metallicity in high-EW_{Lya} LAEs



Result 3: [CII]-Lya

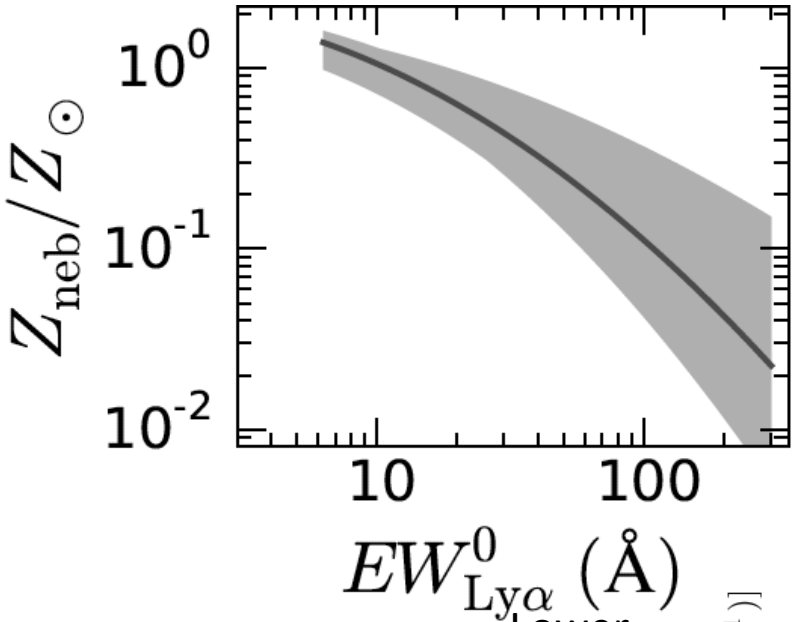
- [CII]/SFR negatively correlates with Lya EW
  - Including results of Carniani+17, 18
  - Confirming [CII] deficit in LAEs for the first time

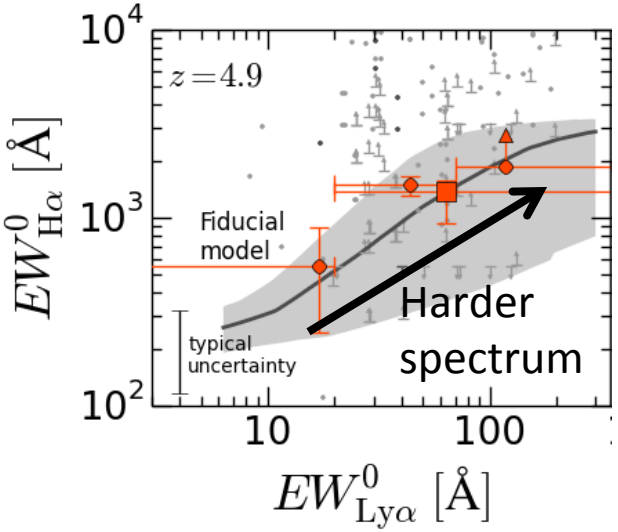
    (see also discussion in Pentericci+16)

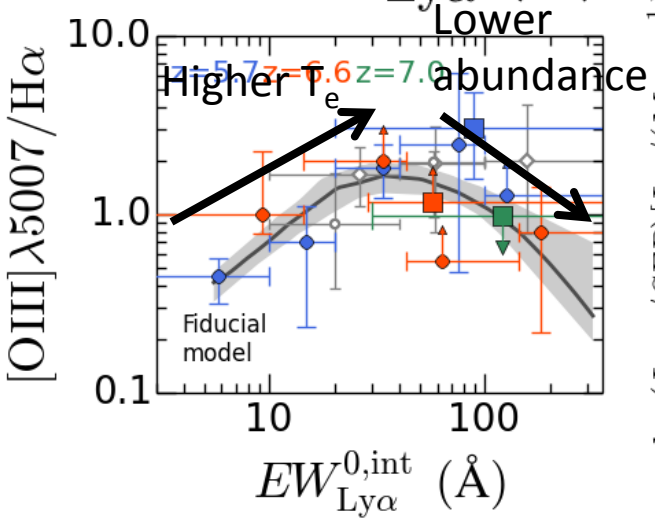


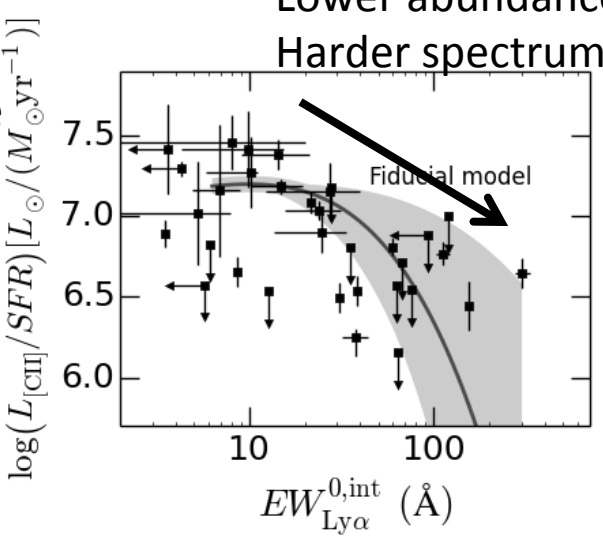
Metallicity-EW Lya Anti-Correlation

- BEAGLE (C
  - Stellar syn dels
  - -2<log(Z/Z ge/yr)<9.1
- Metallicity-E n explain the three relatic



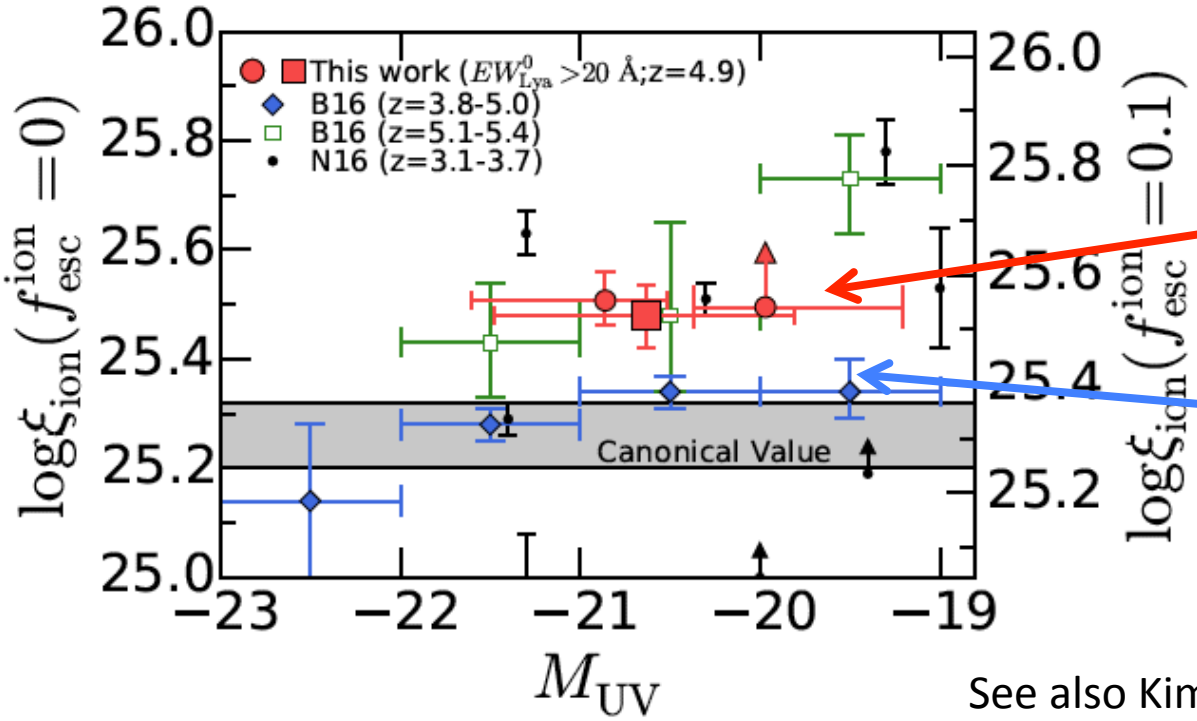






Implication for Cosmic Reionization

- Ionizing photon production efficiency ξ_{ion}
  - $\xi_{ion}=N(H^0)/L_{UV}$, $L_{Ha}=1.36\times10^{-12}N(H^0)(1-f_{esc})$
- $\log\xi_{ion}$~25.53, higher than LBGs by 60-100%
  - Enough ionizing photons (f_{esc}=10%, UVLFs)



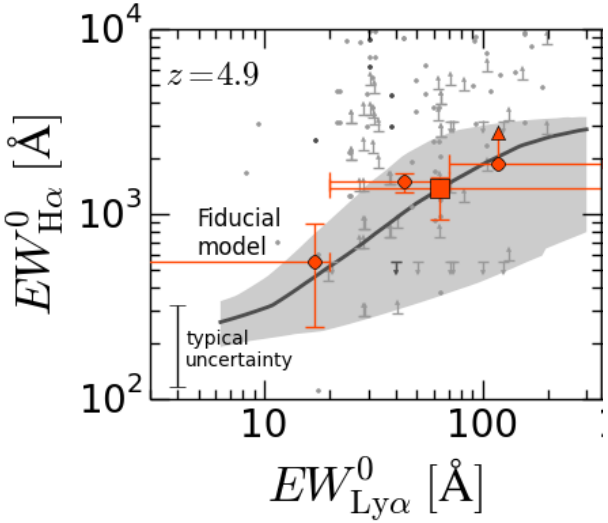
This study (LAE)

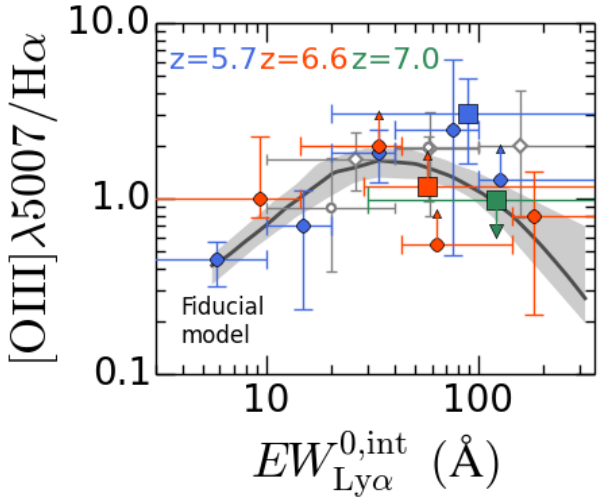
LBG

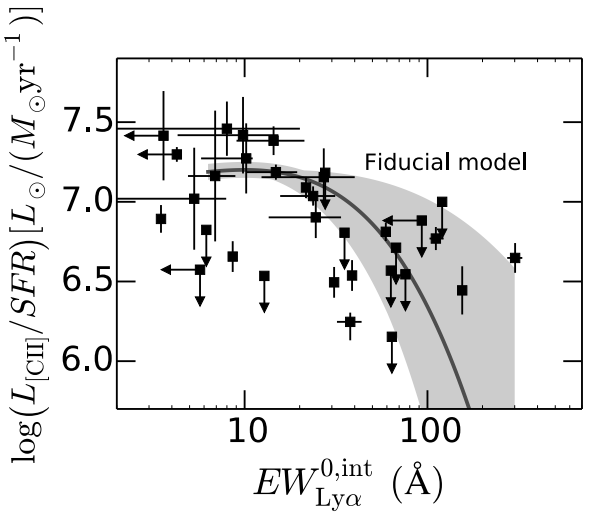
See also Kimihiko's talk yesterday

Summary

- ISM properties from ~1000 LAEs at z=4.9-7.0







- Metallicity-EW_{Lya} anti-correlation can explain all results.
  - LAE: metal poor and high ξ_{ion}