Preliminary Results

A constraint of [NII] 122 μm and a new dust continuum detection of a z = 7.15 Lyman Break Galaxy with ALMA

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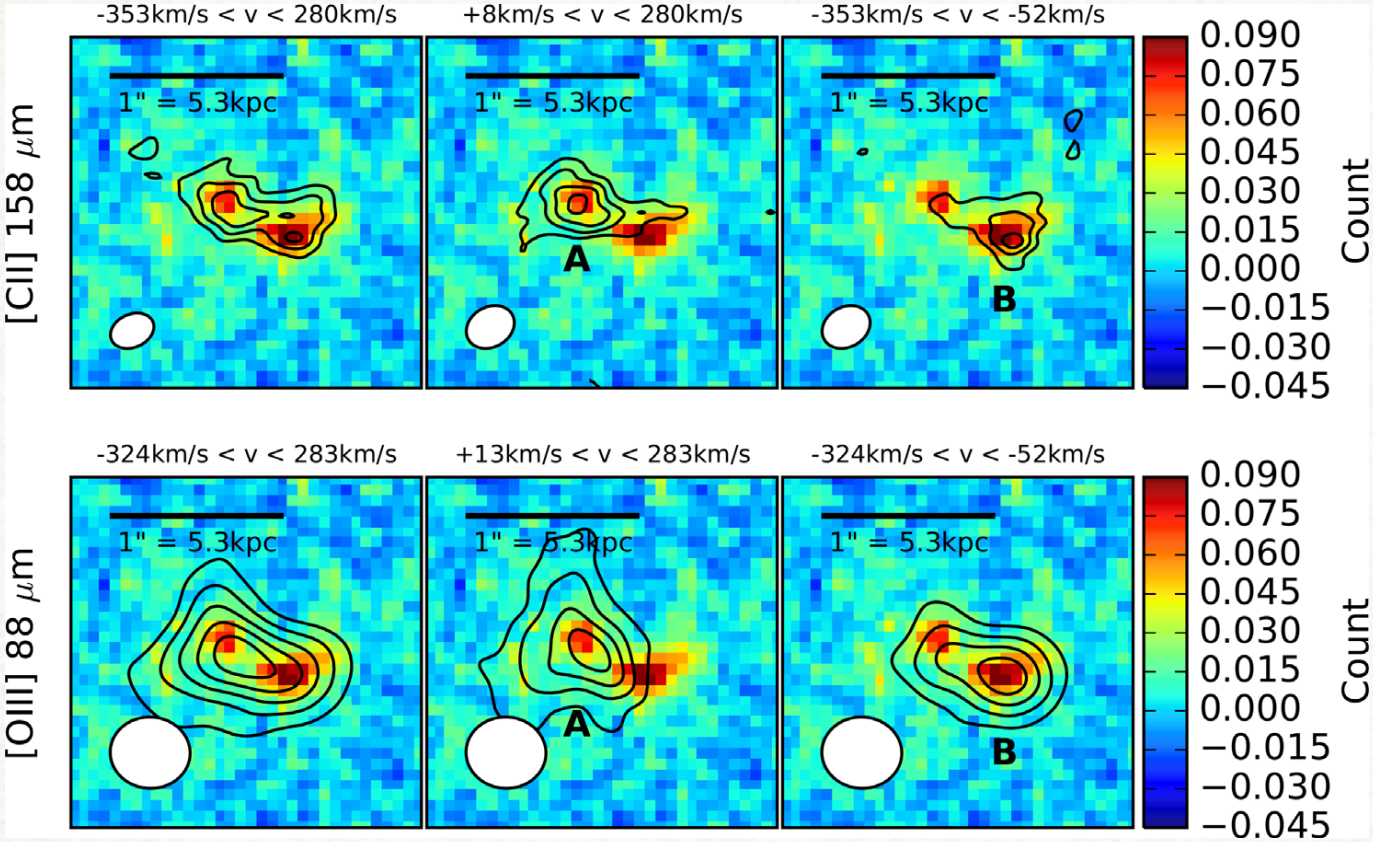
B14-65666 @z = 7.15

- [OIII] 88um, [CII] 158um, dust continuum detected
  - Big Three Dragon (大三元), Hashimoto+19

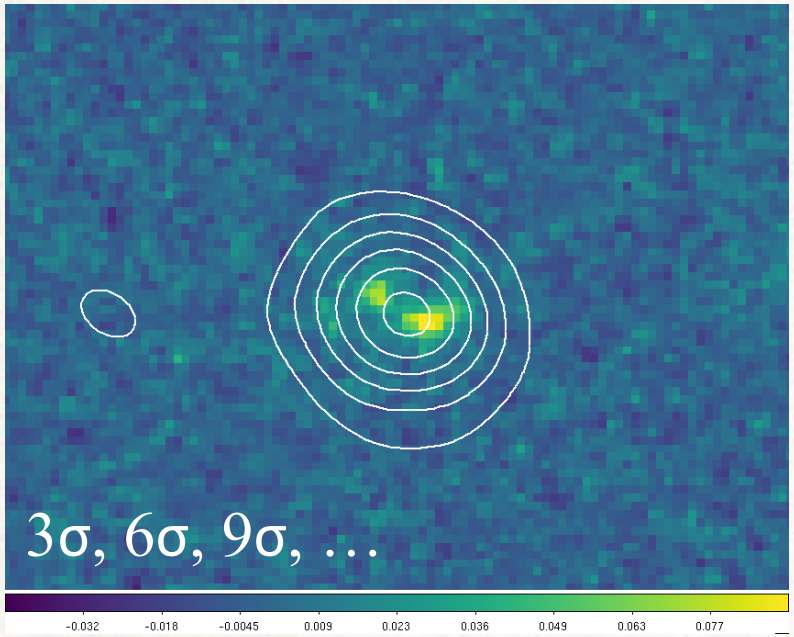


ALMA new observation

- Cycle 7, Band 7 observation (PI: A. K. Inoue)
  - targets: [NII] 122um, dust continuum
  - exp time: 2.4 h

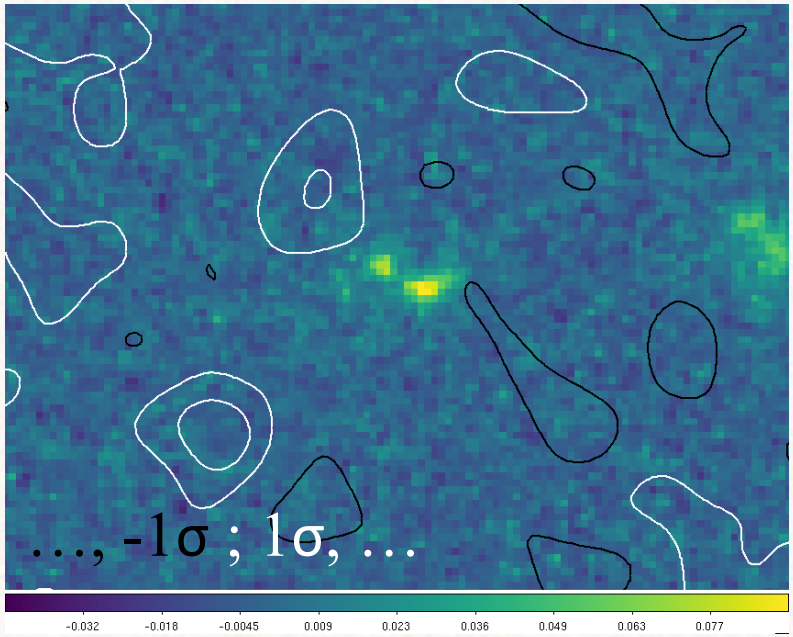
Image

- Dust (120 um)



  - ~19σ detect
  - 218 ± 19 uJy

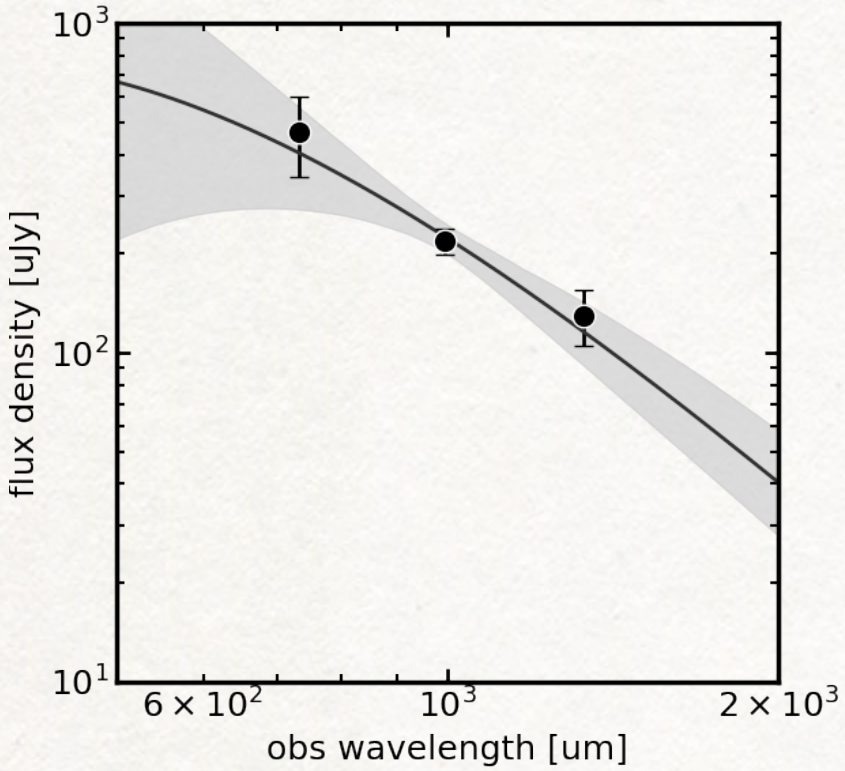
- [NII] 122 um



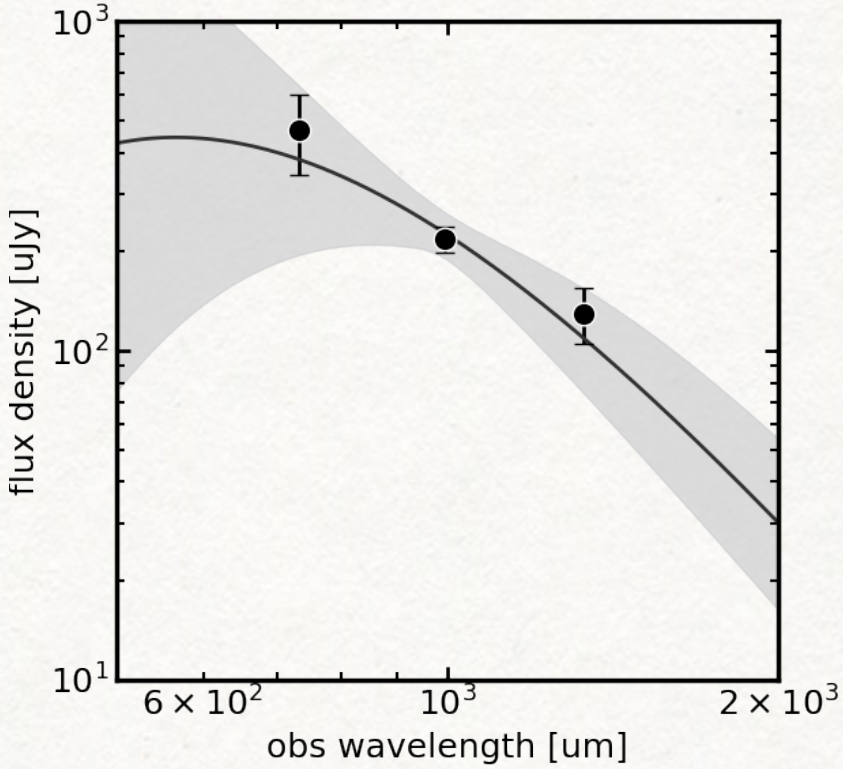
  - 3σ upper limit
  - < 0.025 Jy/beam km/s

FIR SED Fitting

- Beta = -1.0 fix

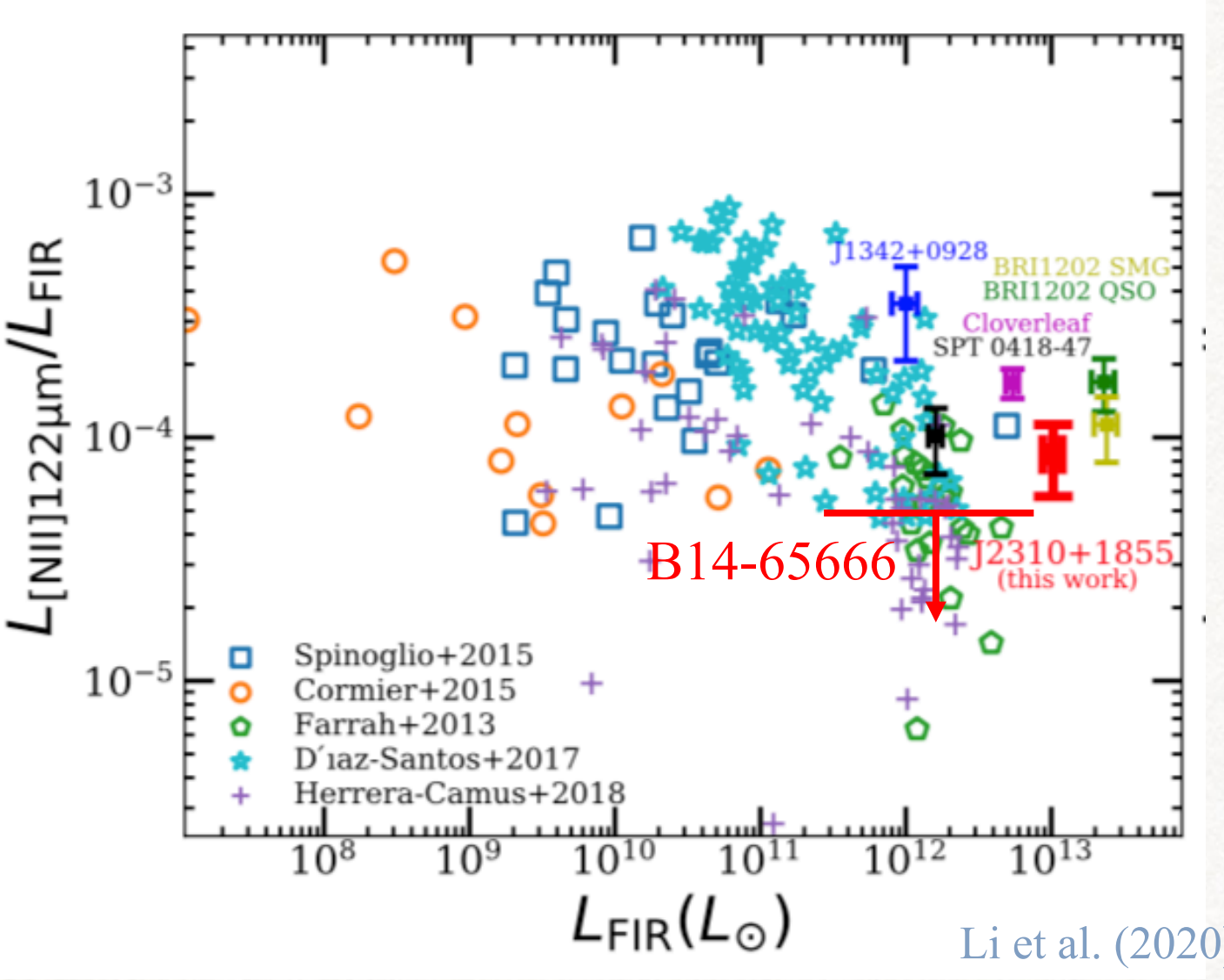


- Beta = -2.0 fix



T > 30 K, but difficult to set upper limit

[NII]/L_{FIR}



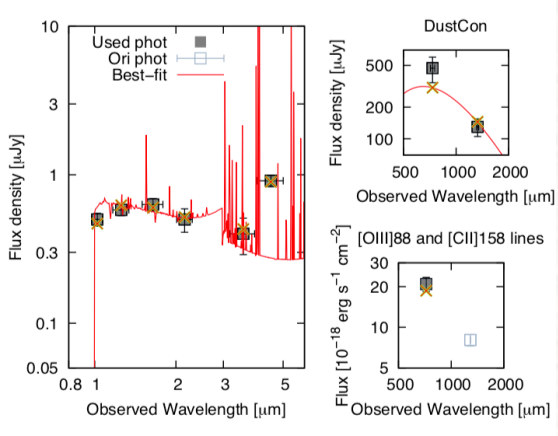
Li et al. (2020)

Discussion

- What can we know from [NII] 122um observation?
  - N/O abundance at high redshift

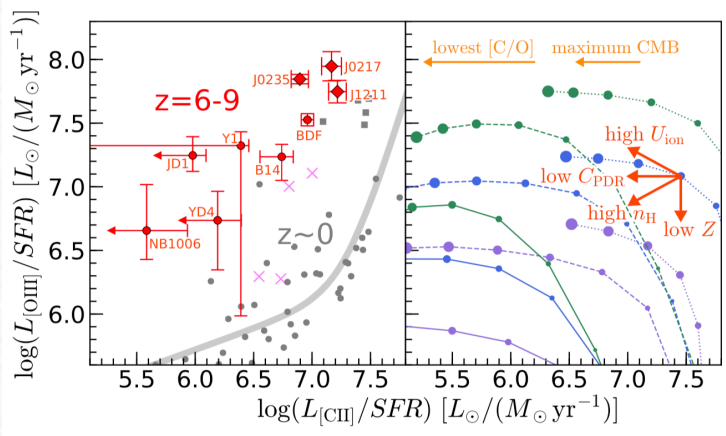
Strategy

- SED fitting (Hashimoto+19)



SFR, metallicity Z

- [OIII]/[CII] (Harikane+20)

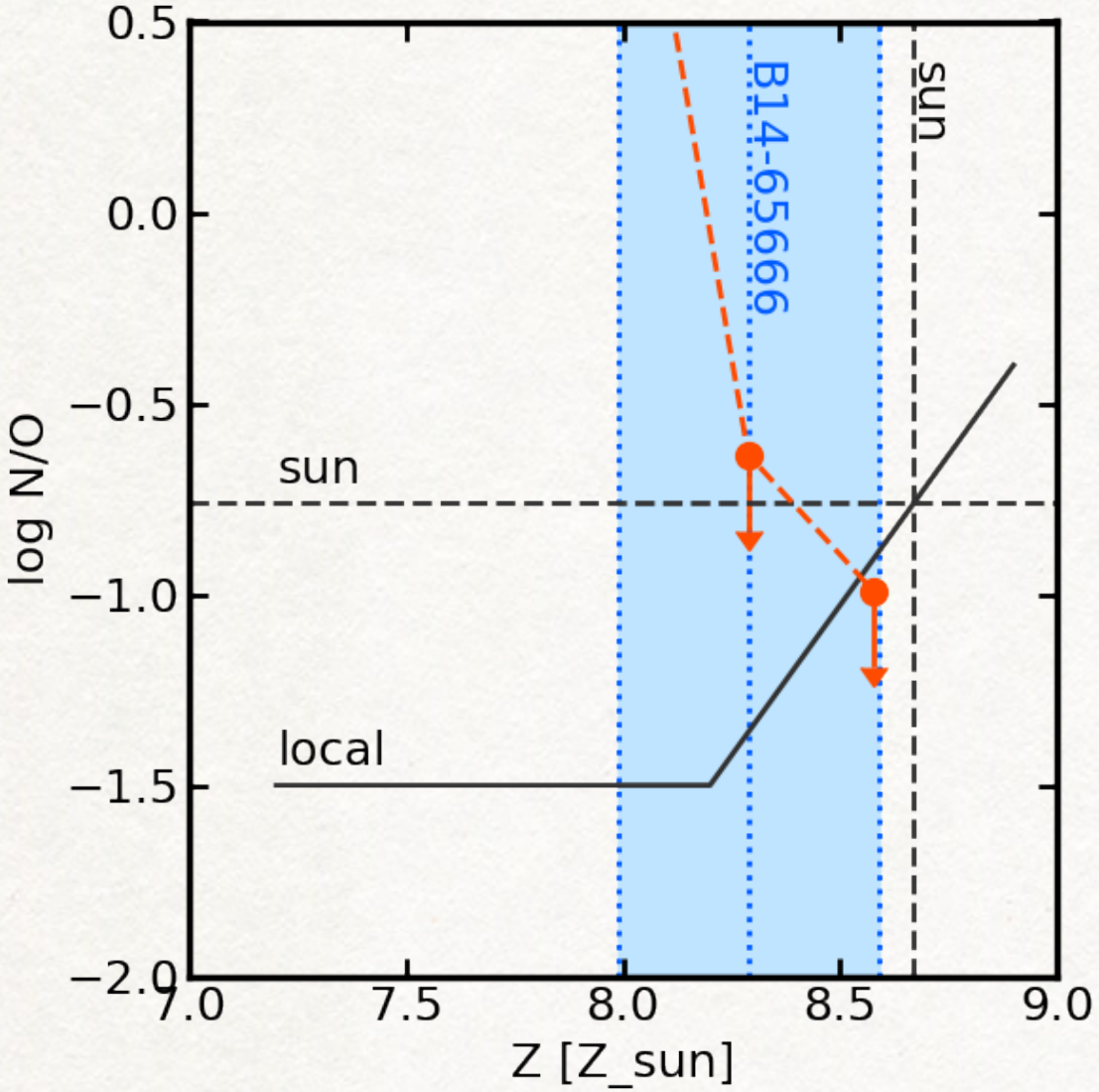


Ionization parameter U
Hydrogen density n_H

- Cloudy calculation
  - [OIII] 88um
  - [NII] 122um

U, n_H, Z → N/O abundance

N/O abundance



At high-Z:

lower than solar N/O

At low-Z:

no strong limit

Discussion

- What can we know from [NII] 122um observation?
  - N/O abundance at high redshift
  - Redshift evolution of BPT diagram

BPT diagram

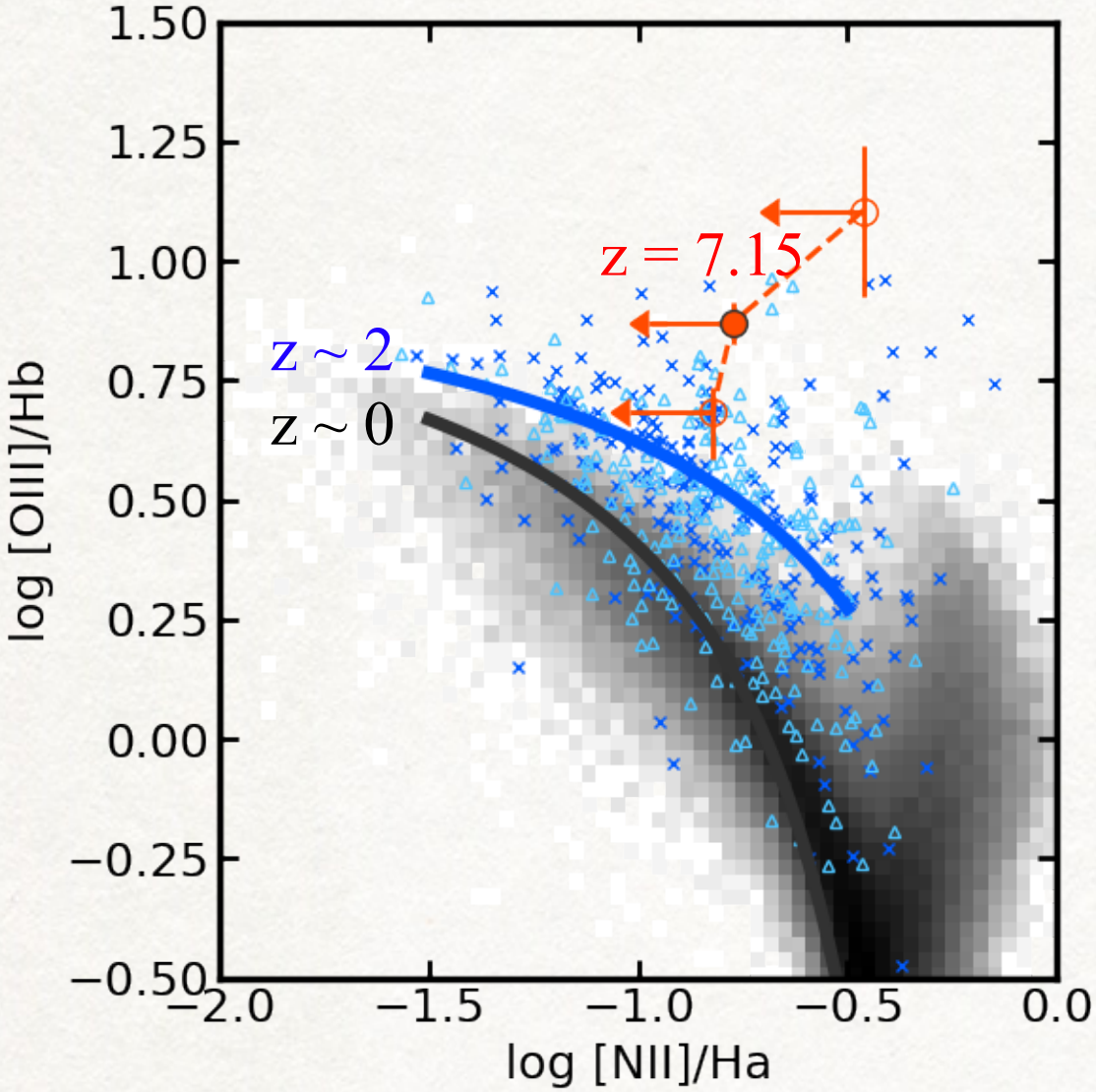
- From multi-wavelength SED fitting (Hashimoto+19)
  - SFR_{SED} → Ha
  - SFR_{SED} → Hb

  (Kenniccut+02)

- Cloudy calculation
  - [OIII] 88um → [OIII] 5007 A
  - [NII] 122um → [NII] 6583 A

  (U, n_H, Z)

BPT diagram



Ionization states in galaxies show evolutional trend at z ~ 0 → 7.

z ~ 0 SDSS

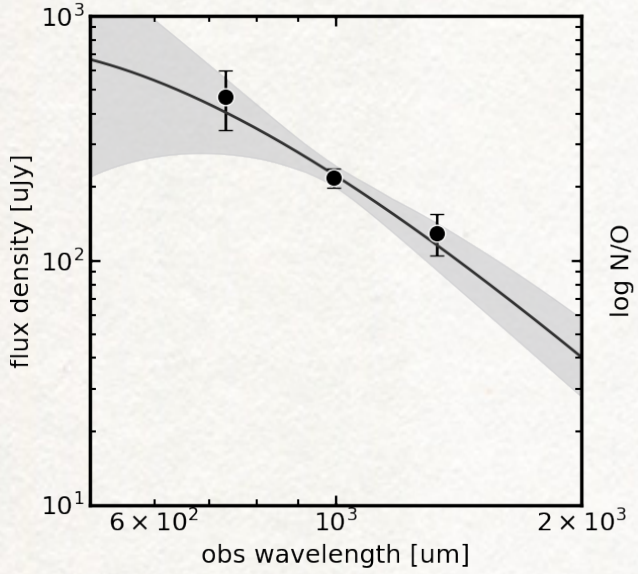
z ~ 2 Strom+18

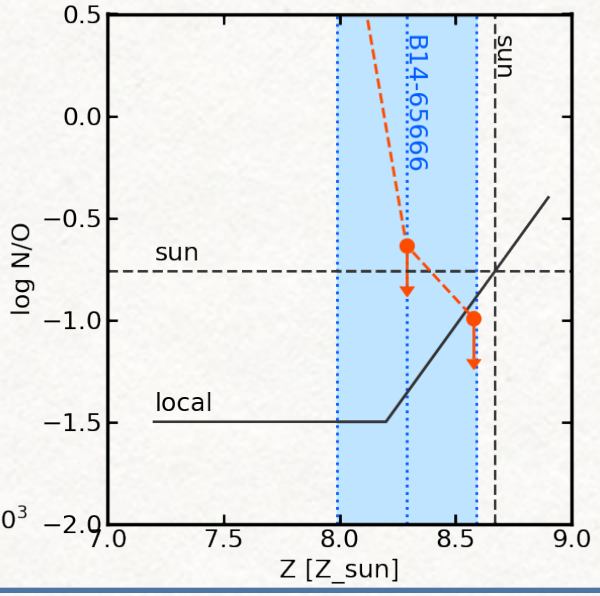
z ~ 2 Shivaei+19

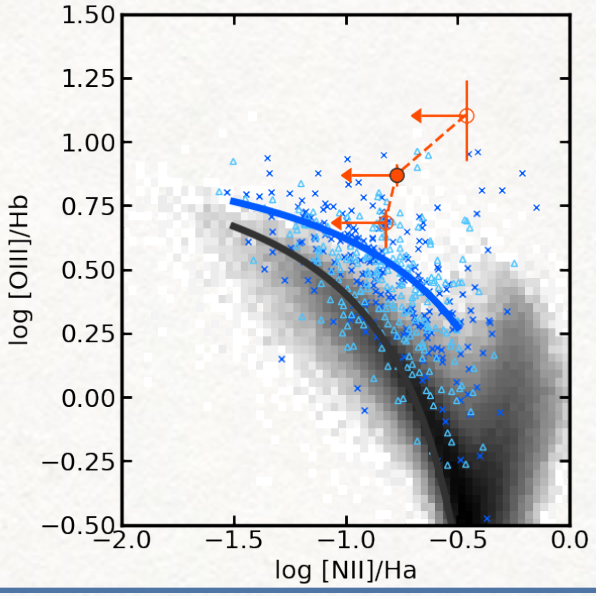
Summary

Preliminary Results, so Stay Tuned!

- 18σ dust detection & 3σ [NII] upper limit on B14-65666
  - Dust temperature T > 30K
  - Sub solar N/O if high-Z
  - Evolutional trend at z ~ 0 → 7 on BPT diagram

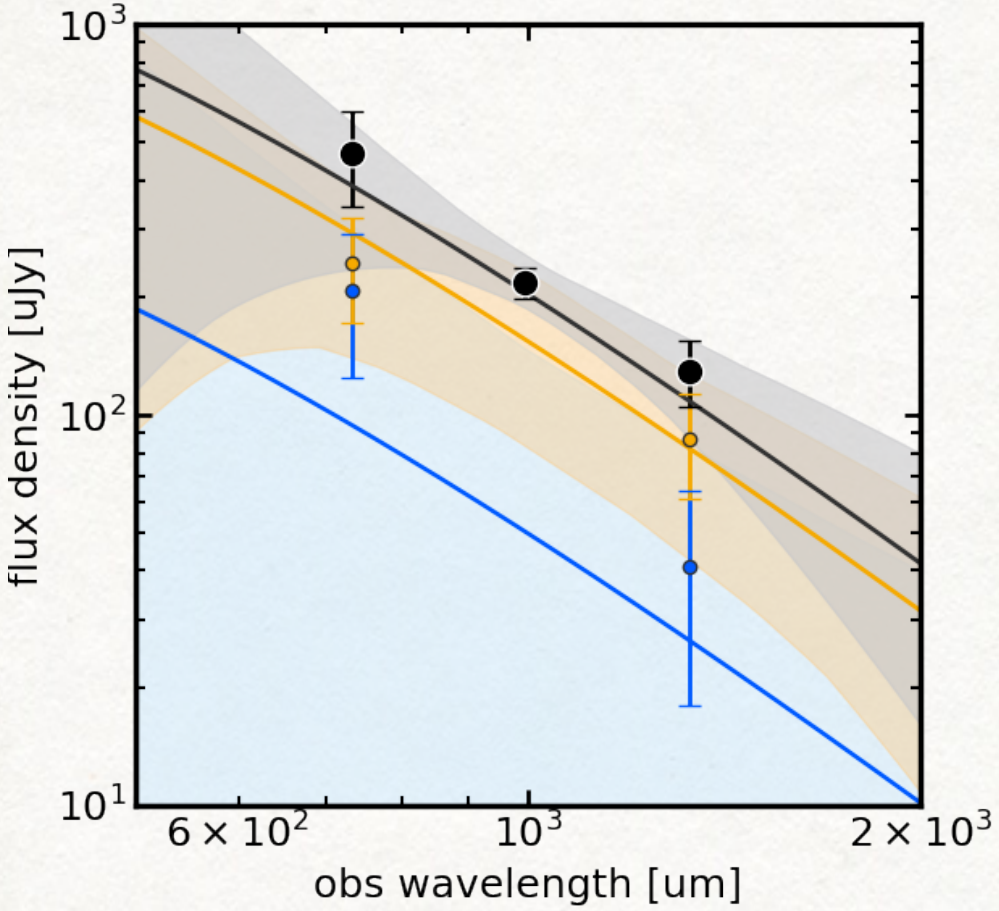




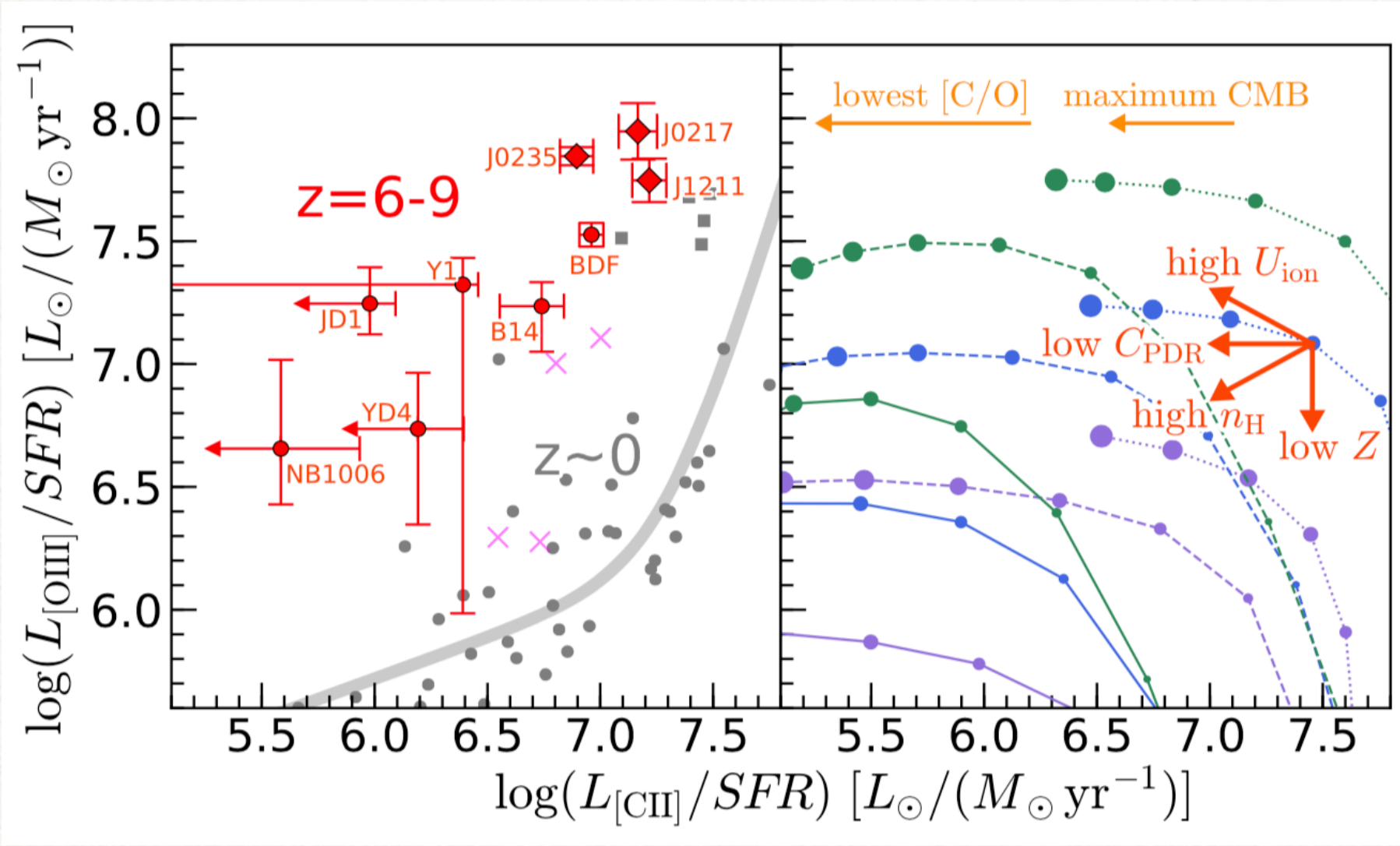


FIR SED Fitting

- Beta, T free



Strategy


z=6-9
J0235
J0217
J1211
BDF
Y1
JD1
B14
YD4
NB1006
z~0
lowest [C/O]
maximum CMB
high $U_{\rm ion}$
low $C_{\rm PDR}$
high $n_{\rm H}$
low Z
$\log(L_{[\rm OIII]}/SFR)\ [L_\odot/(M_\odot\,{\rm yr}^{-1})]$
$\log(L_{[\rm CII]}/SFR)\ [L_\odot/(M_\odot\,{\rm yr}^{-1})]$
8.0
7.5
7.0
6.5
6.0
5.5
6.0
6.5
7.0
7.5