Spectroscopic characterization of galaxies at 9.5 < z < 12.5 in the Abell2744 field

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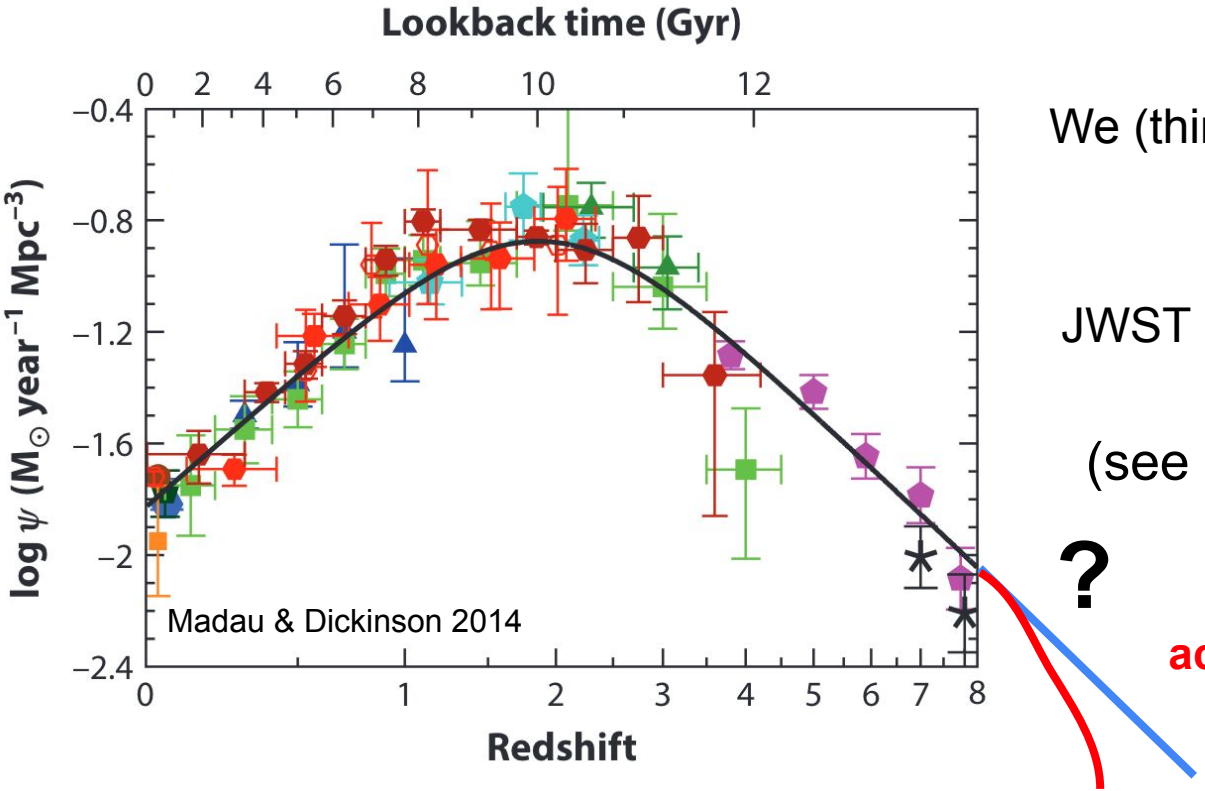
***Collaborators**: P. Arrabal-Haro, A. Calabrò, M. Dickinson, A. Fontana, S. Mascia*

An open question:
Star Formation Rate Density at z = 10



We (think we) know well the evolution of the SFRD at z < 8!

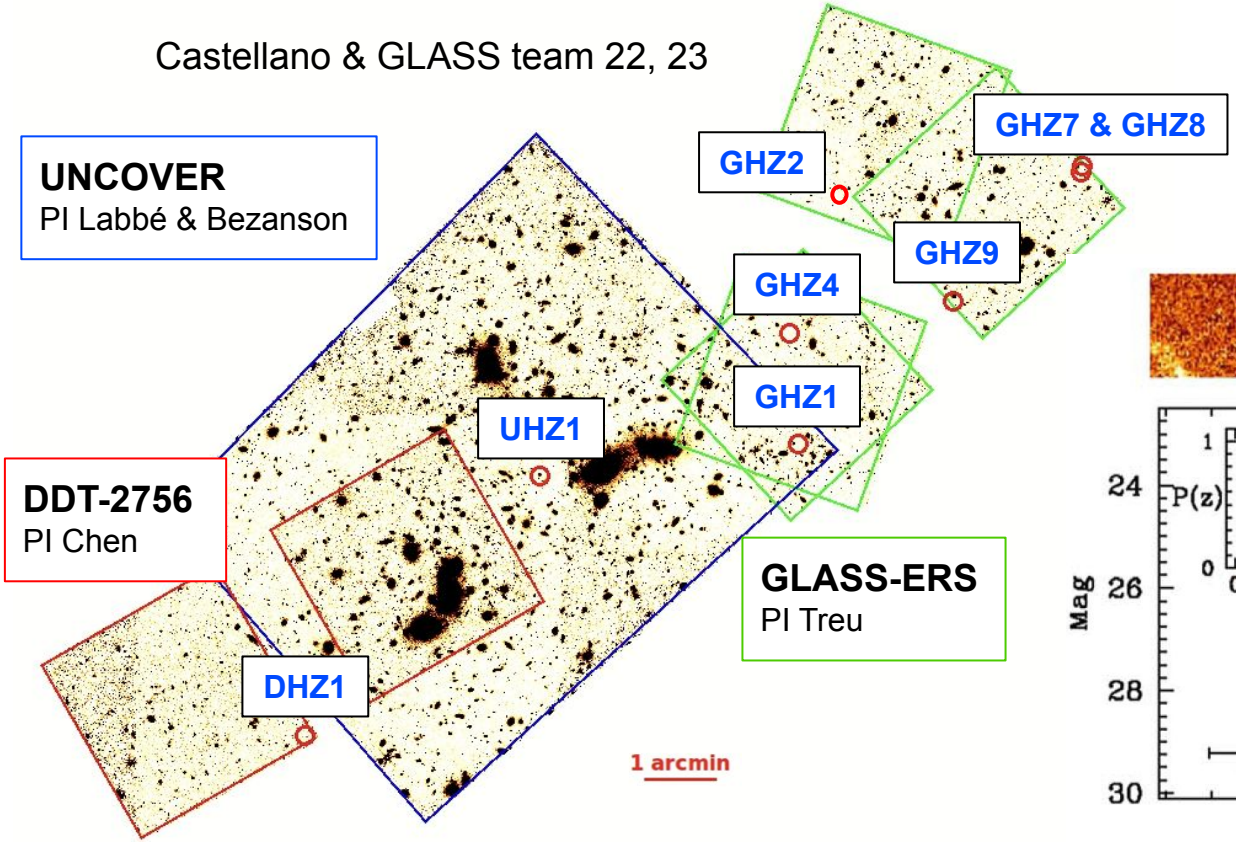
JWST has opened the exploration of the UVLF at z > 10
(see *Yuichi* and *Callum's* talks)

?

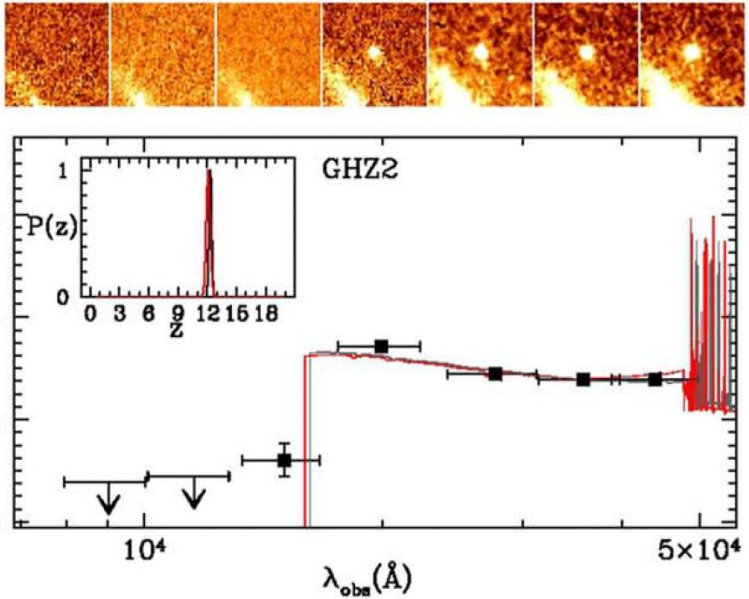
Continued smooth or
accelerated decline at z > 8?

Robust z > 9 candidates in the A2744 field

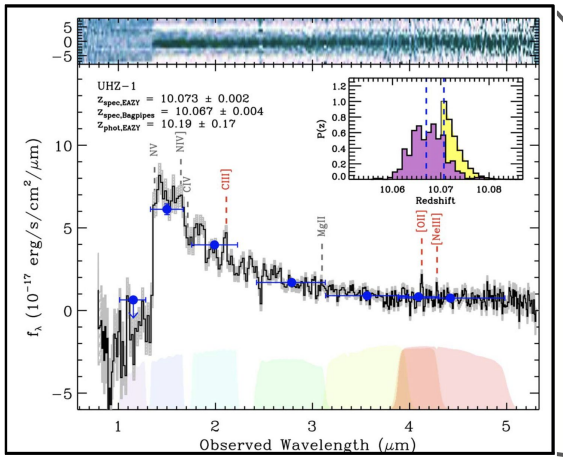
Castellano & GLASS team 22, 23



See also: Naidu+22, Atek+23, McLeod+24

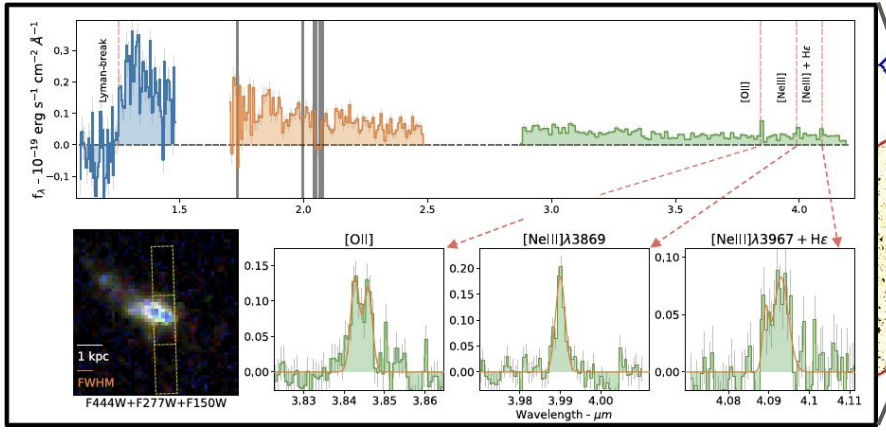


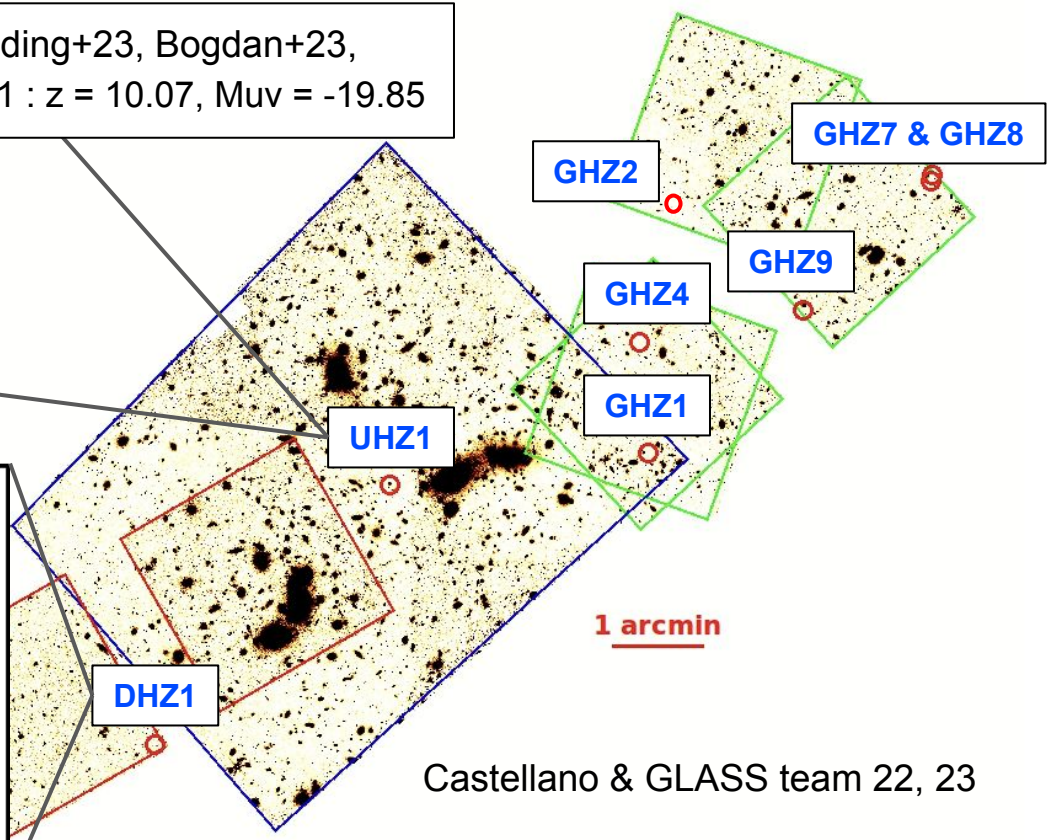
Spectroscopic confirmations in the A2744 field



Goulding+23, Bogdan+23,
UHZ1 : z = 10.07, Muv = -19.85

Boyett+23, DHZ1: z = 9.31, Muv= −*20.92*

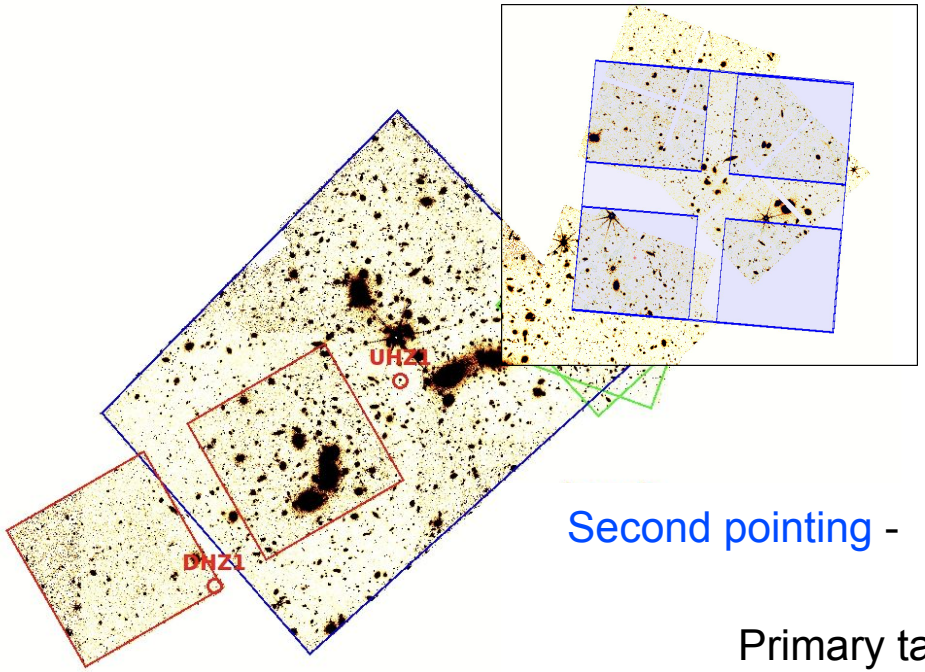




Castellano & GLASS team 22, 23

NIRSpec follow-up of GLASS ERS
(GO-3073, PI Castellano)

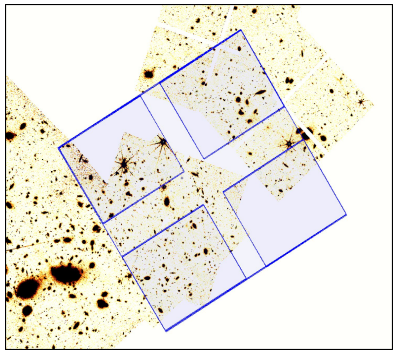
12 hours of NIRSpec PRISM on 2 pointings to confirm z ~ 9 - 12 galaxies in the GLASS-ERS area



First pointing - Observed on Oct. 25 2023

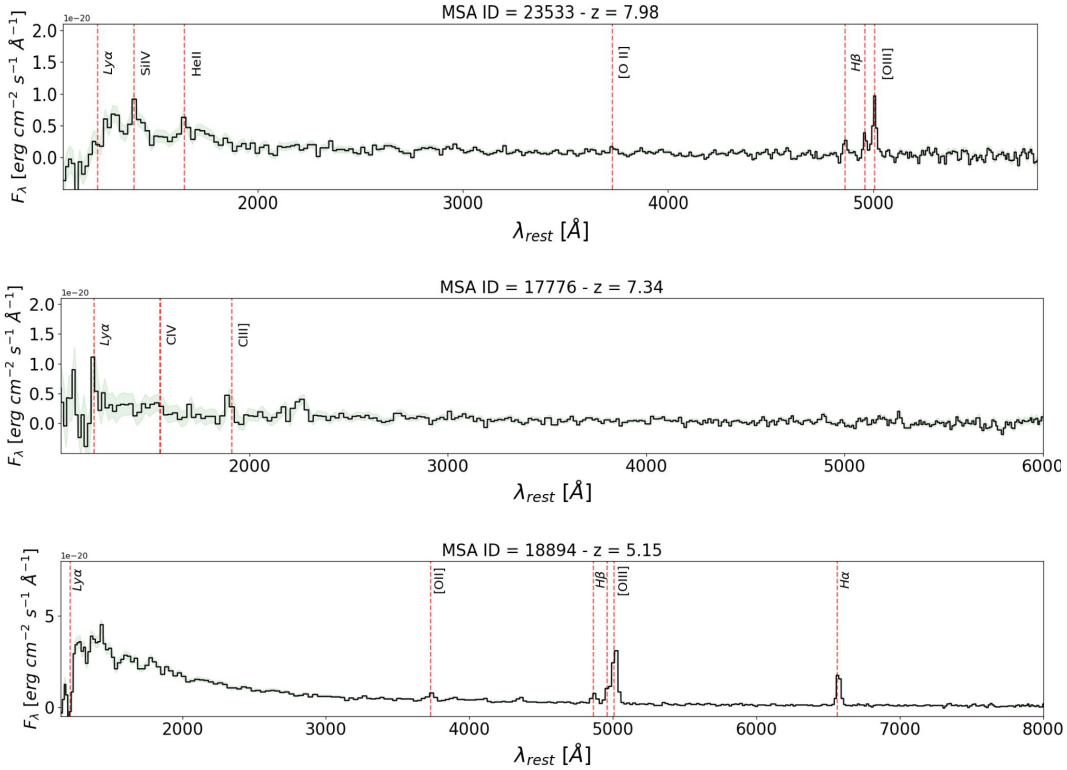
Primary targets:
GHZ2, GHZ7, GHZ8, GHZ4, GHZ9

Second pointing - Planned for June/July 2024
Few weeks from now!
Primary targets: GHZ1, GHZ4, GHZ9



New spec-z confirmations at z ≥ 9.5

(Napolitano+24b, in prep.)



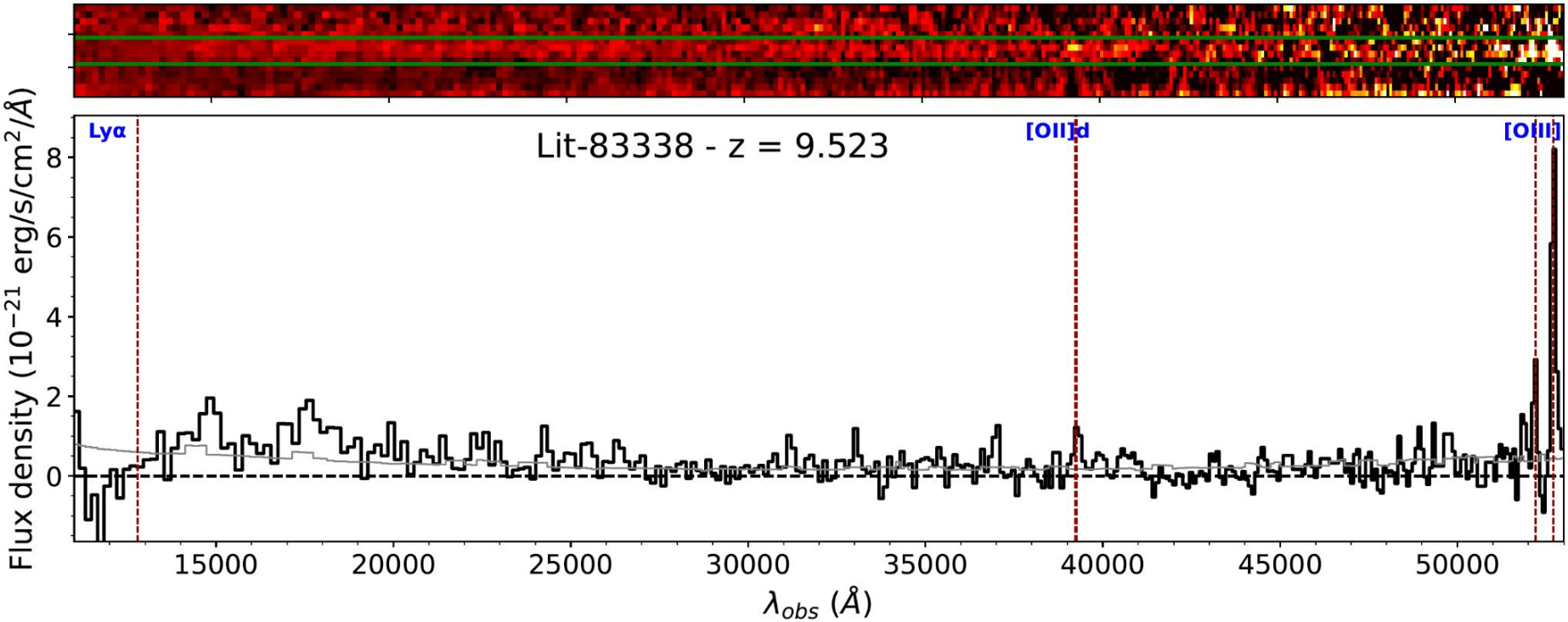
214 redshift identifications

Data reduction by L. Napolitano

GLASS-83338 - z = 9.523 ± 0.004

a candidate from Atek+23

β = - 2.63 ± 0.25 Muv = -19.24



GLASS-83338 - z = 9.523 ± 0.004

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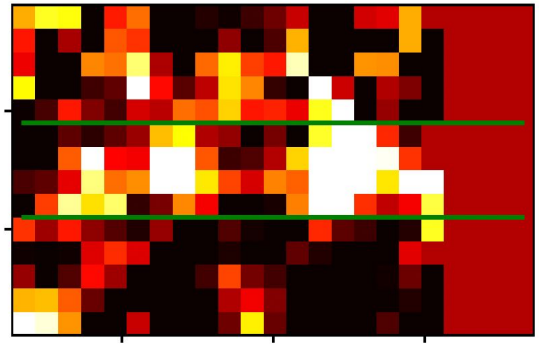
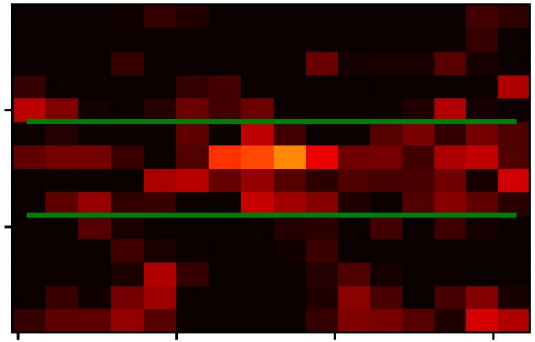
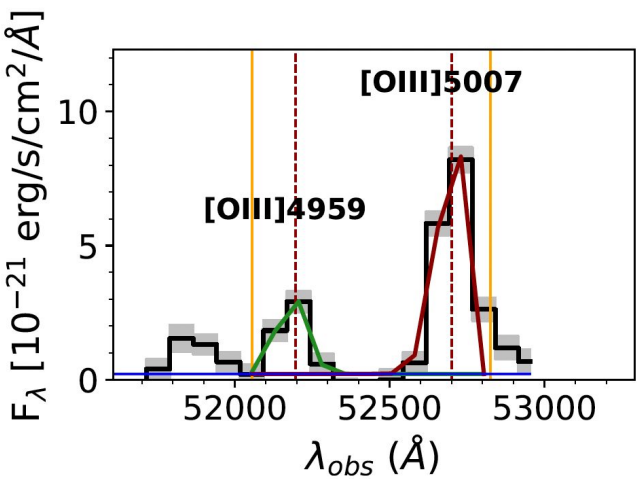
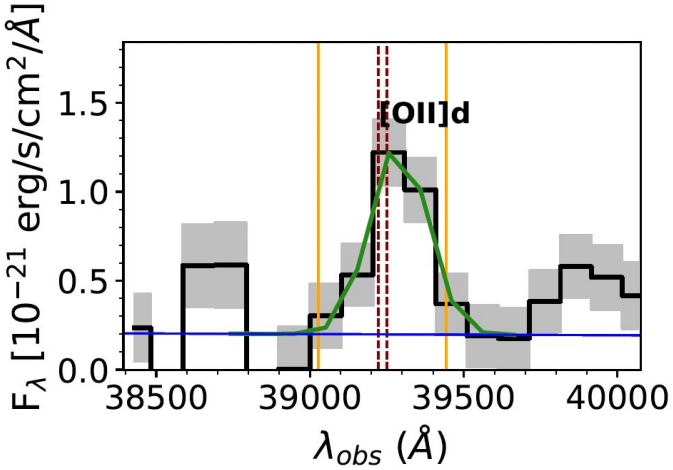






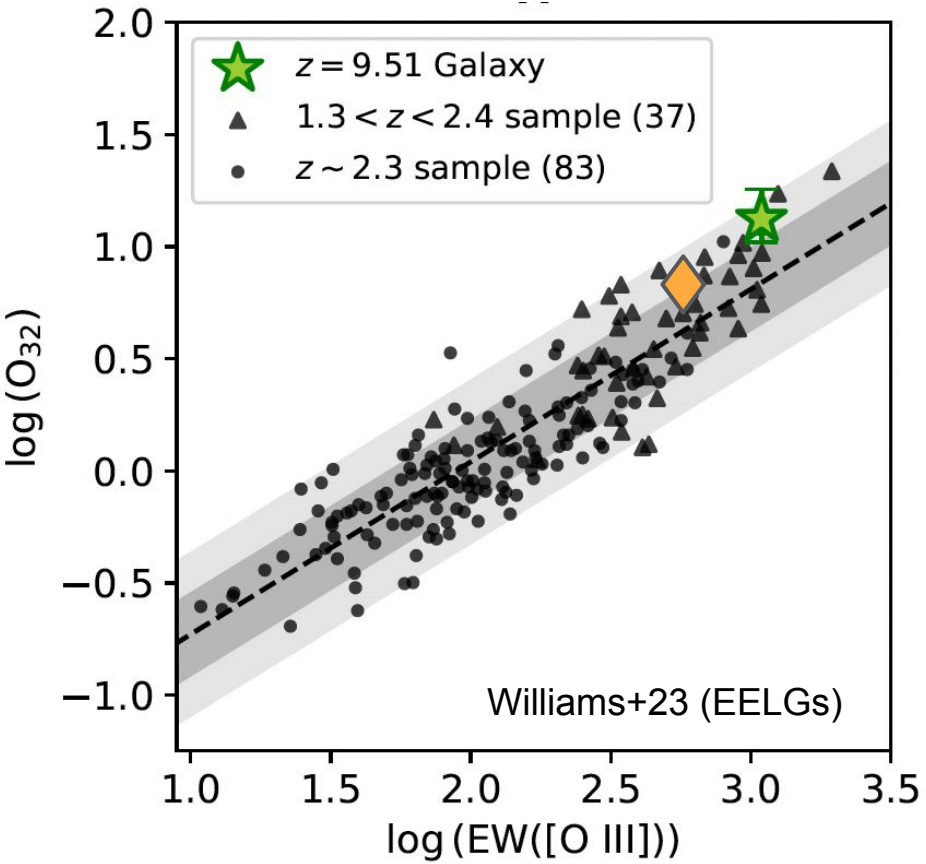


Emission lines detected at SNR > 3

Modeling with a Gaussian fit and local continuum subtraction

GLASS-83338 - z = 9.523 ± 0.004

a candidate from Atek+23



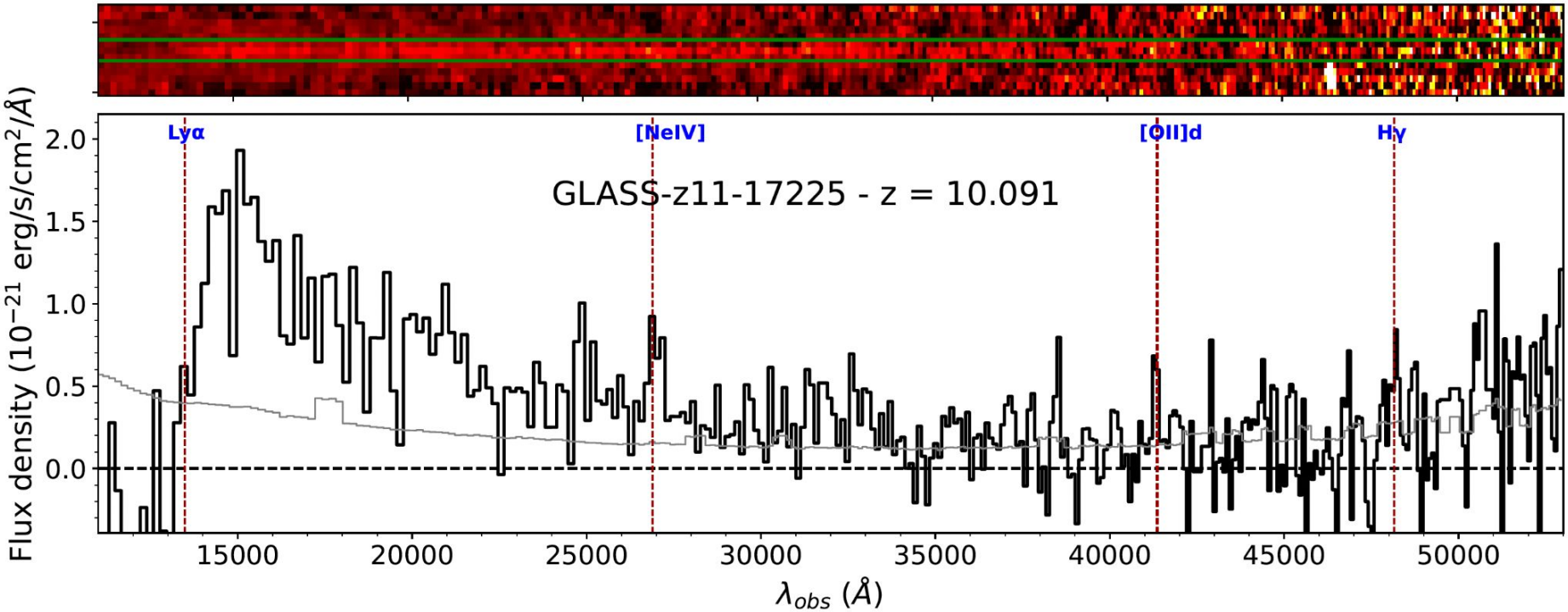
O32 = 6.5 ± 1.1

[OIII]5006/[OIII]4959
= 3.5 ± 0.6

GLASS-z11-17225 - z = 10.091 ± 0.010

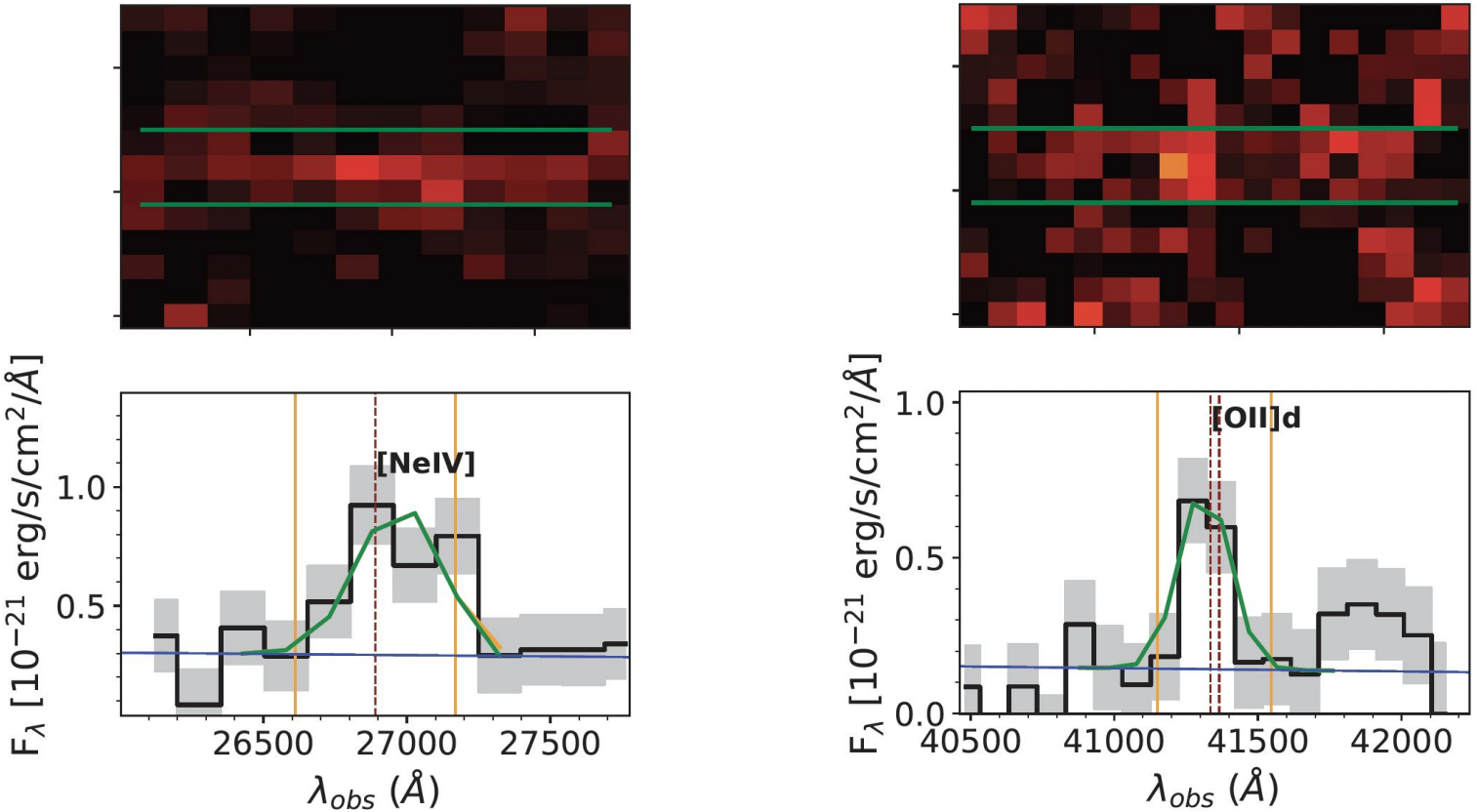
a candidate from McLeod+24

β = - 2.55 ± 0.21 Muv = -19.08



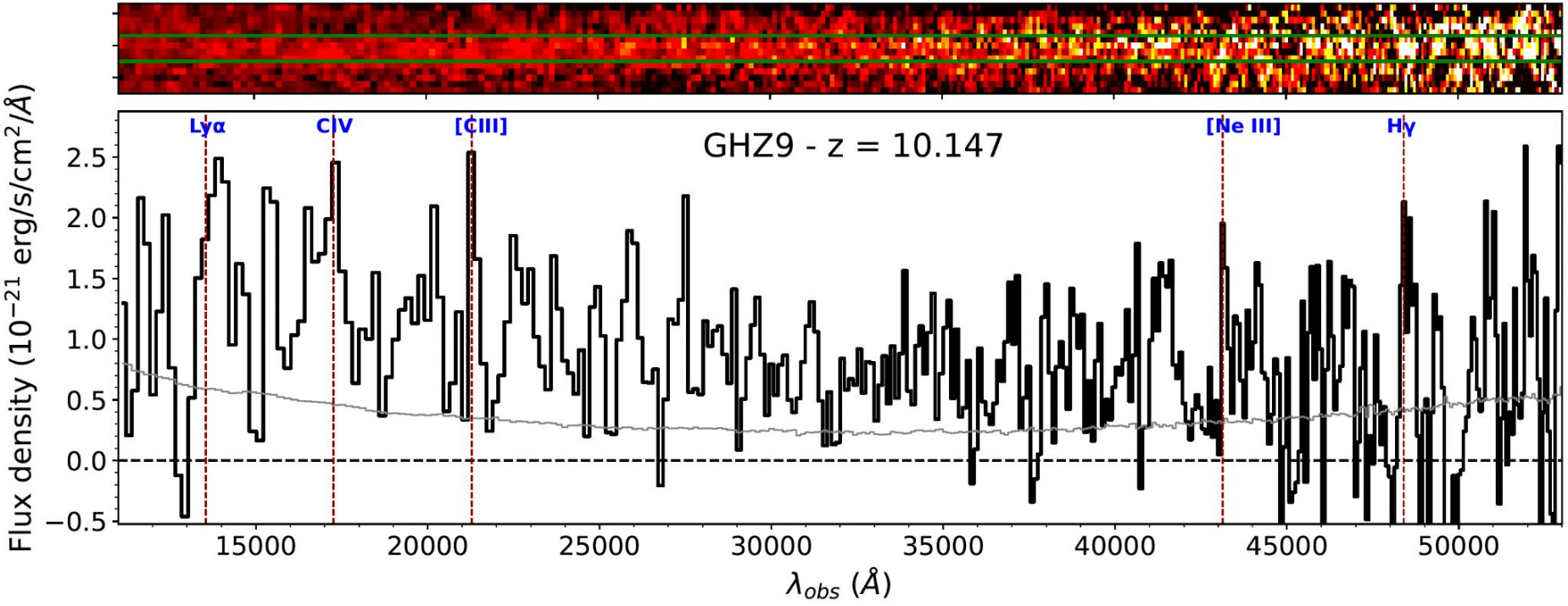
GLASS-z11-17225 - z = 10.091 ± 0.010

a candidate from McLeod+24



GHZ9 - z = 10.147

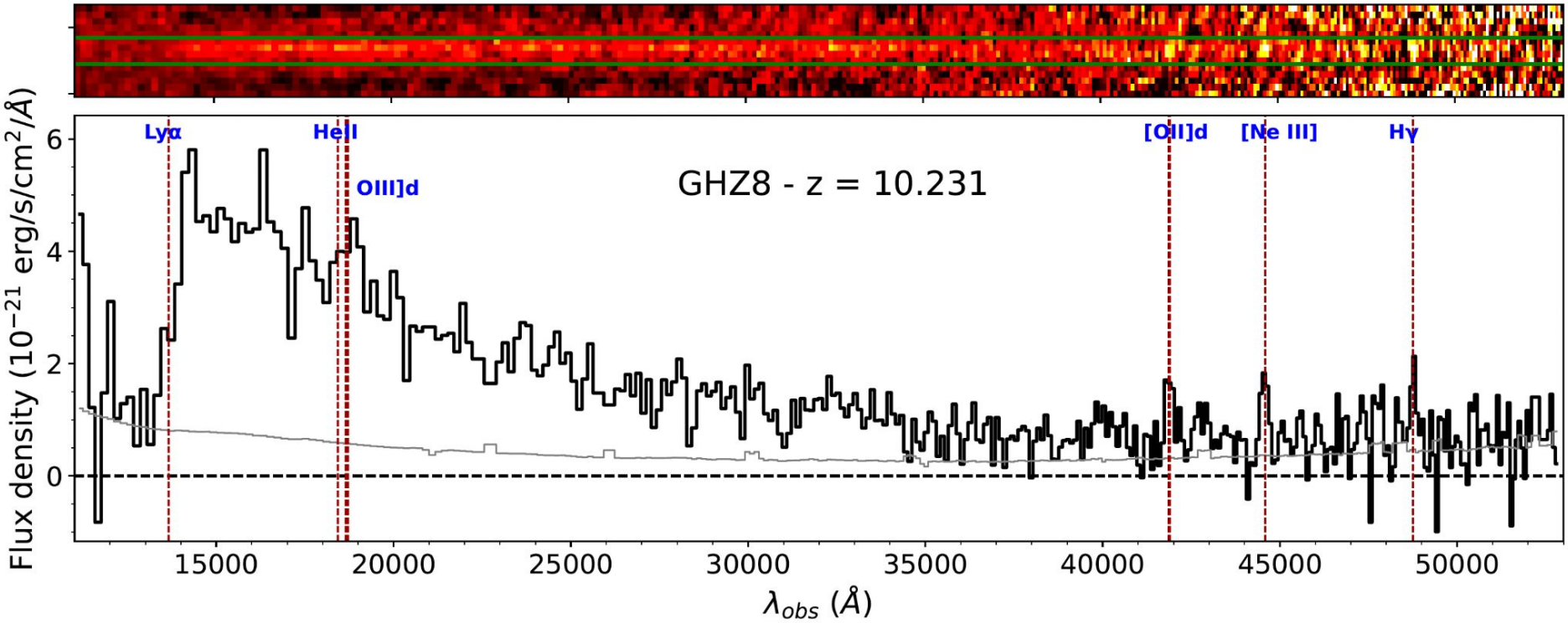
a candidate from Castellano+23



GHZ8 - z = 10.231 ± 0.007

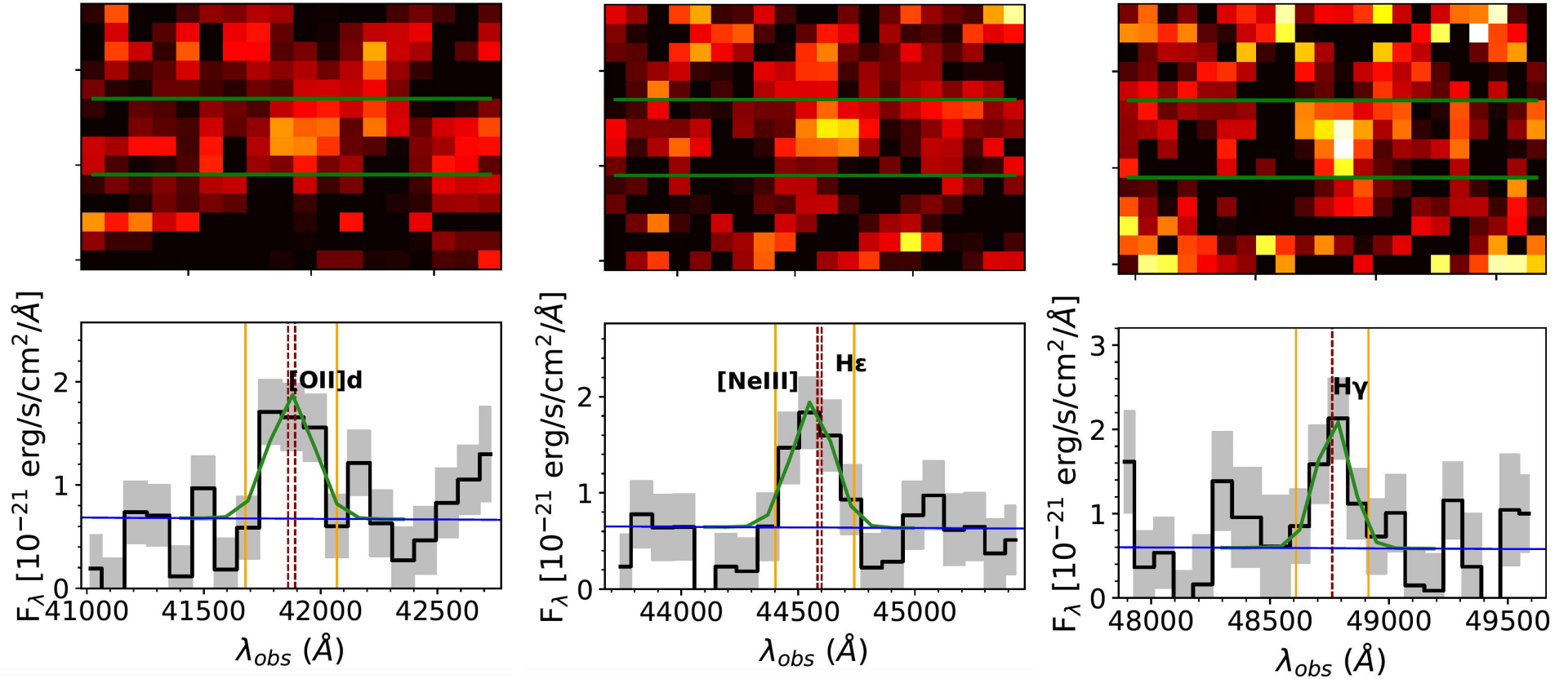
a candidate from Castellano+23

β = - 2.26 ± 0.11 Muv = - 20.73



GHZ8 - z = 10.231 ± 0.007

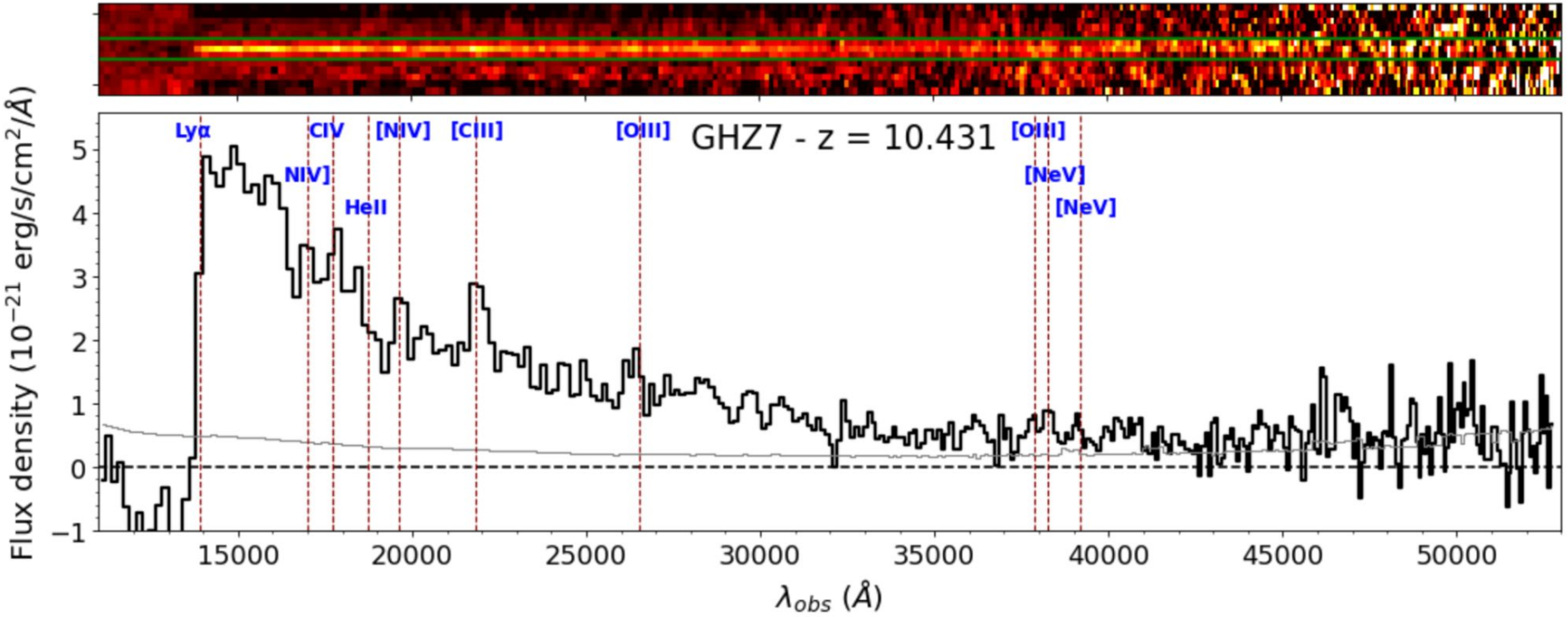
a candidate from Castellano+23



GHZ7 - z = 10.431 ± 0.031

a candidate from Castellano+23

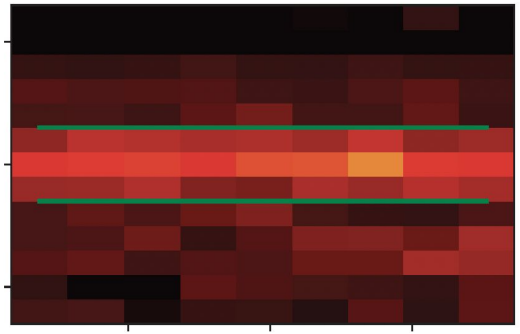
β = - 2.25 ± 0.10 Muv = -20.06

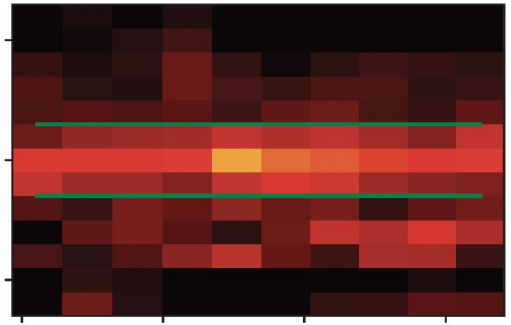


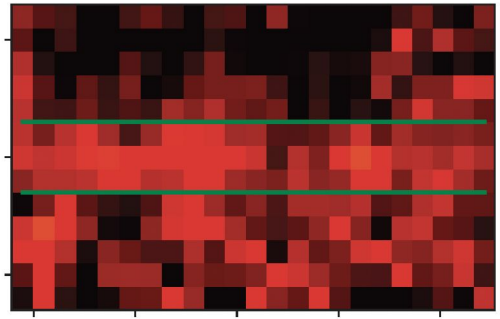
GHZ7 - z = 10.431 ± 0.031

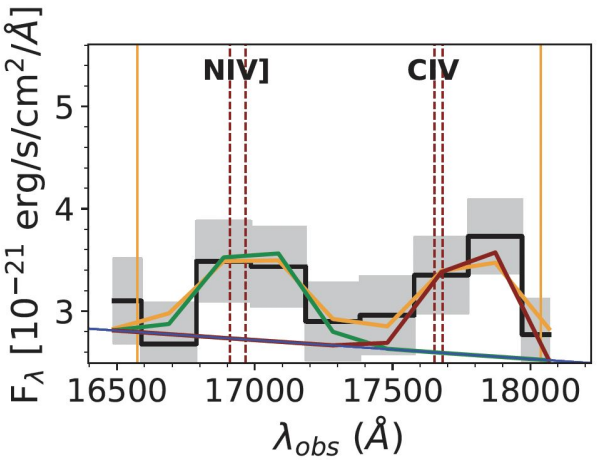
a candidate from Castellano+23

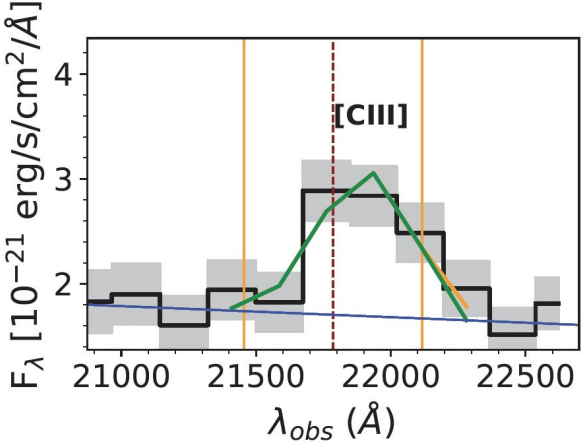
97.11 eV are required!

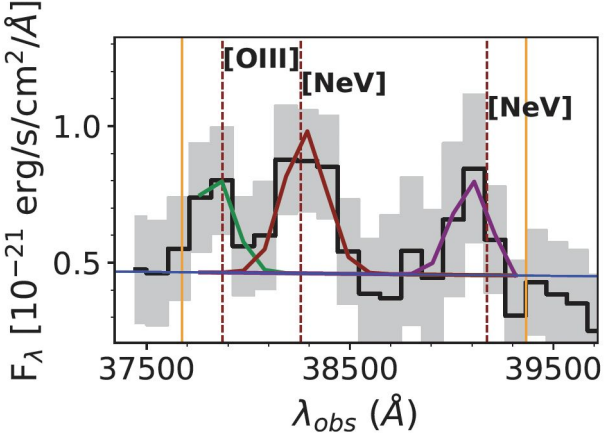








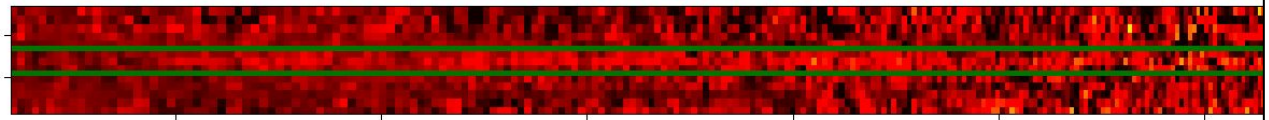


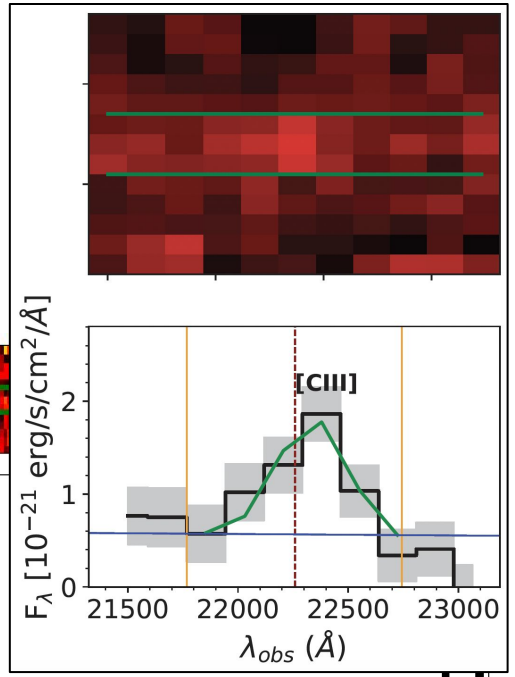


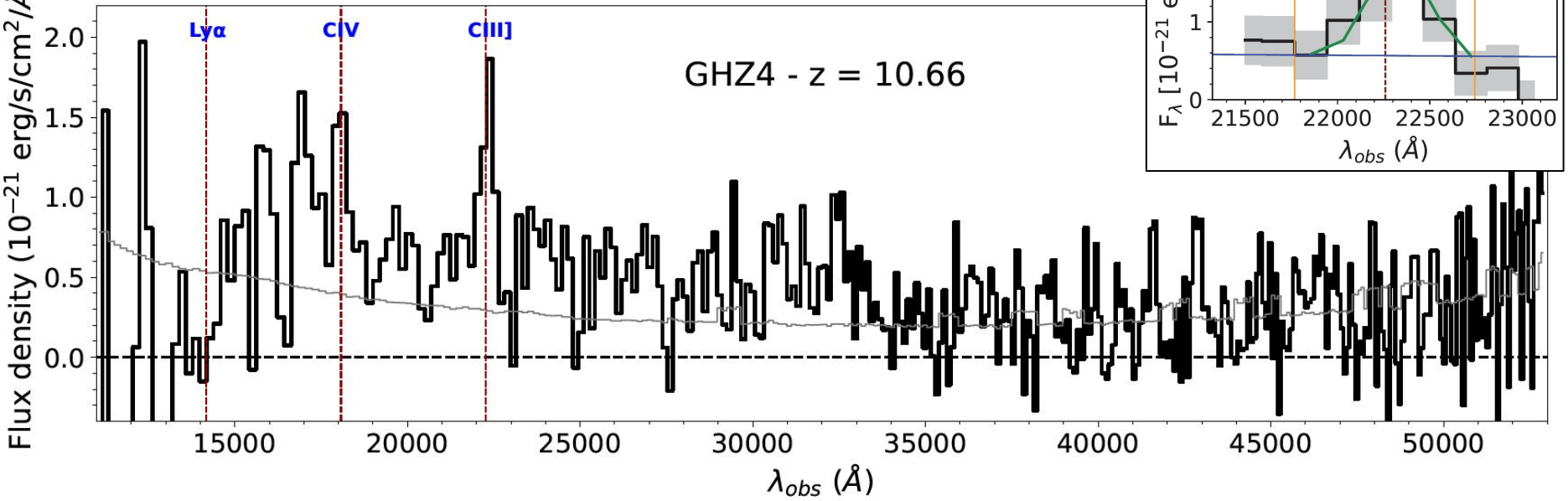
GHZ4 - z = 10.66 ± 0.11

a candidate from Castellano+23

β = -2.27 ± 0.31 Muv = -19.44



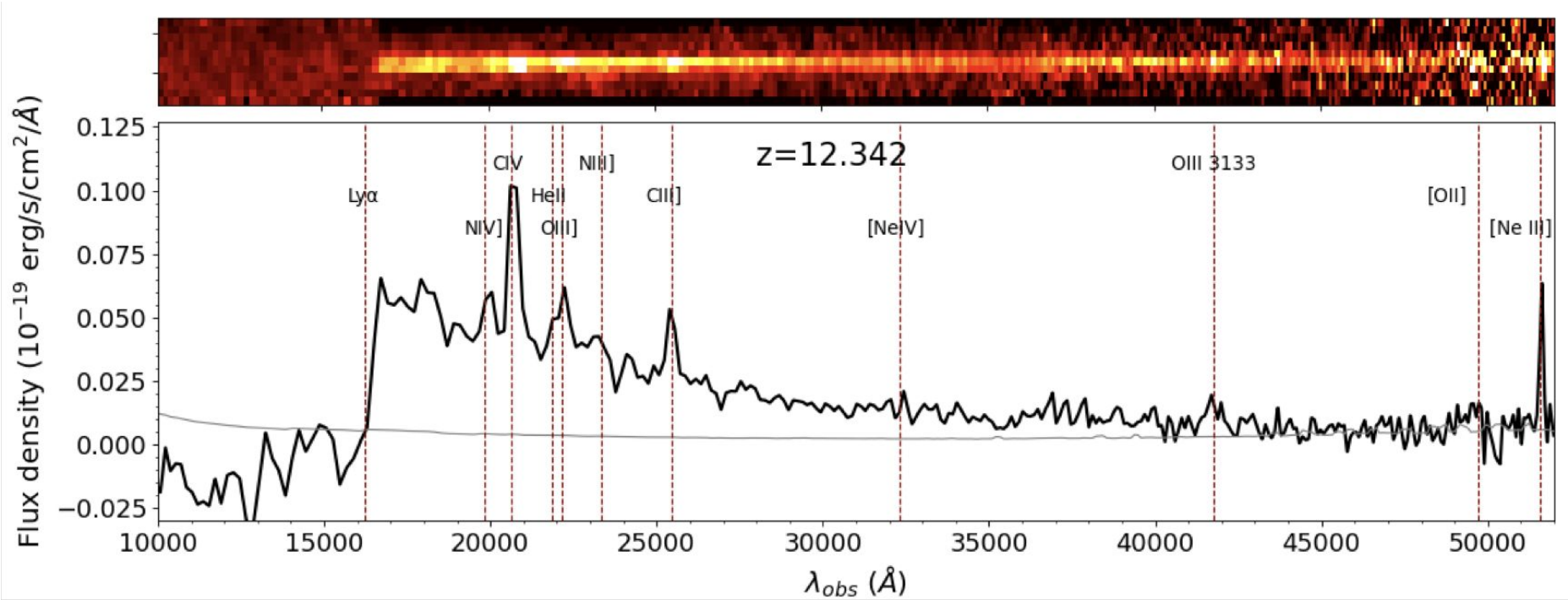




GHZ2/GLASS-z12 - z = 12.342 ± 0.009

a candidate from Castellano+22, Naidu+22

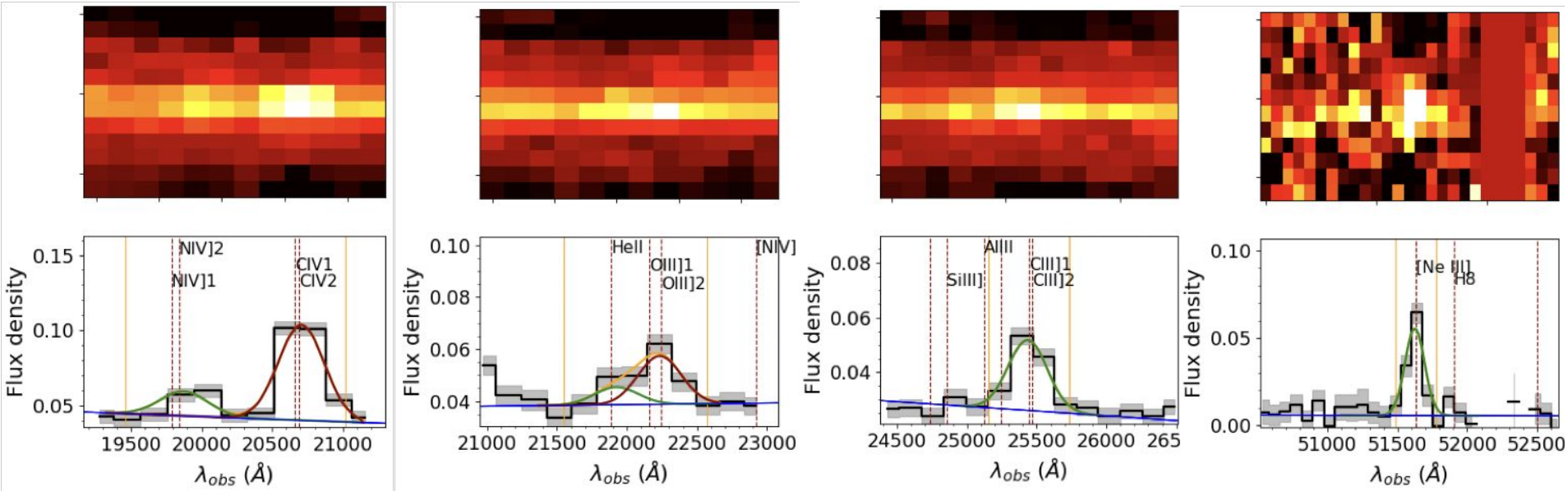
β = -2.46 ± 0.08 Muv = -21.19



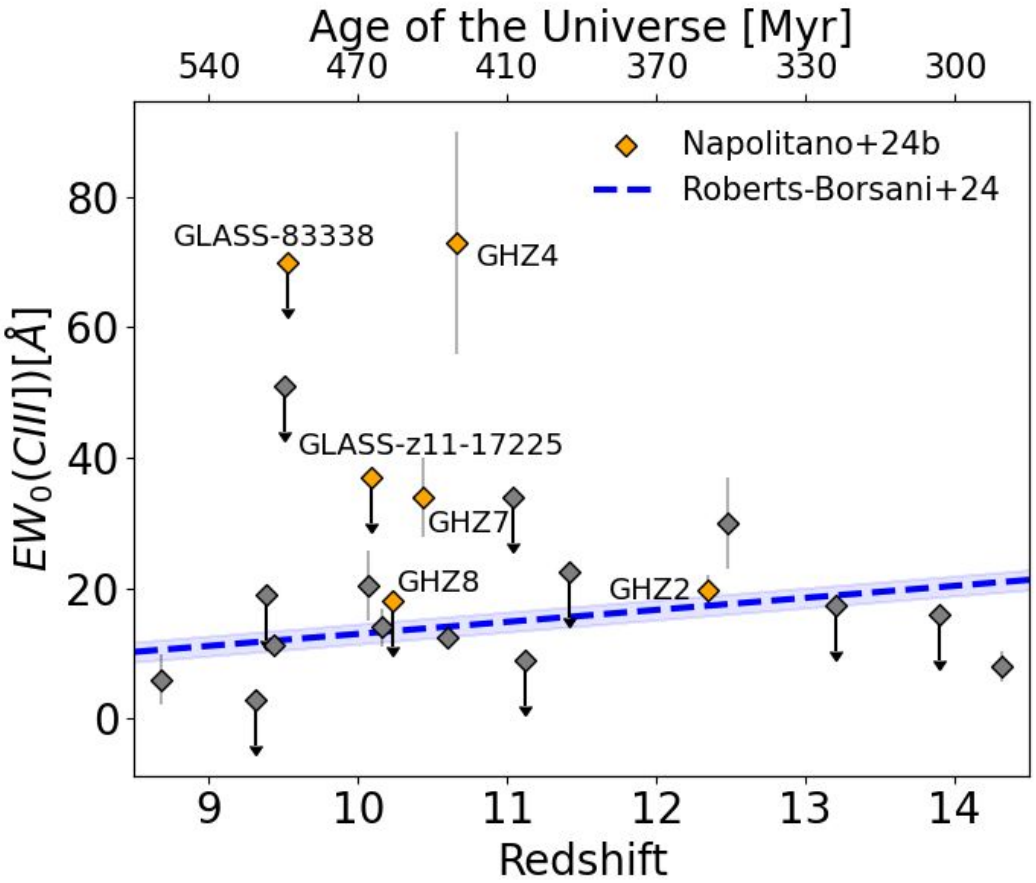
Castellano, LN+24 arXiv:2403.10238; Zavala+24 arXiv:2403.10491, Calabrò, LN+24 arXiv:2403.12683

GHZ2/GLASS-z12 - z = 12.342 ± 0.009

a candidate from Castellano+22, Naidu+22



CIII] emission evolution



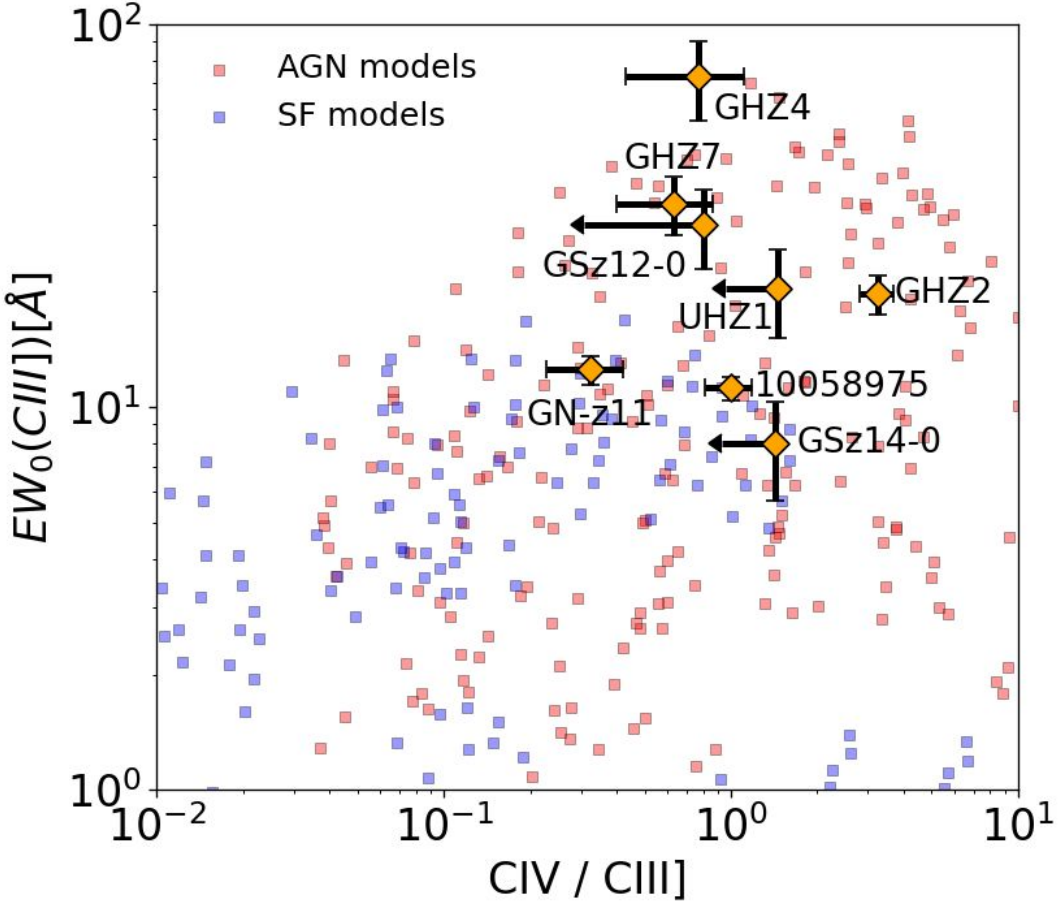
CIII] emitters from literature:

Arrabal-Haro+23, Bunker+23a,b, D'Eugenio+23, Goulding+23, Hsiao+23, Williams+23, Carniani+24, Hainline+24, and Maiolino+24

Roberts-Borsani+24
from stacks:

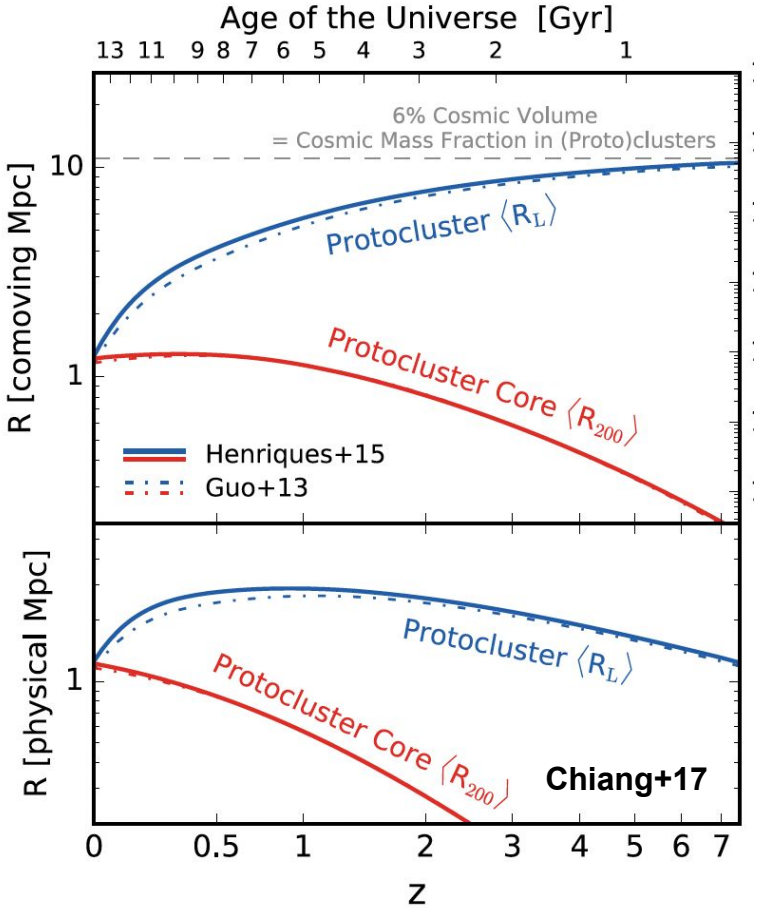
$EW_0(\text{ CIII] }) = 1.84 \times z - 5.38$

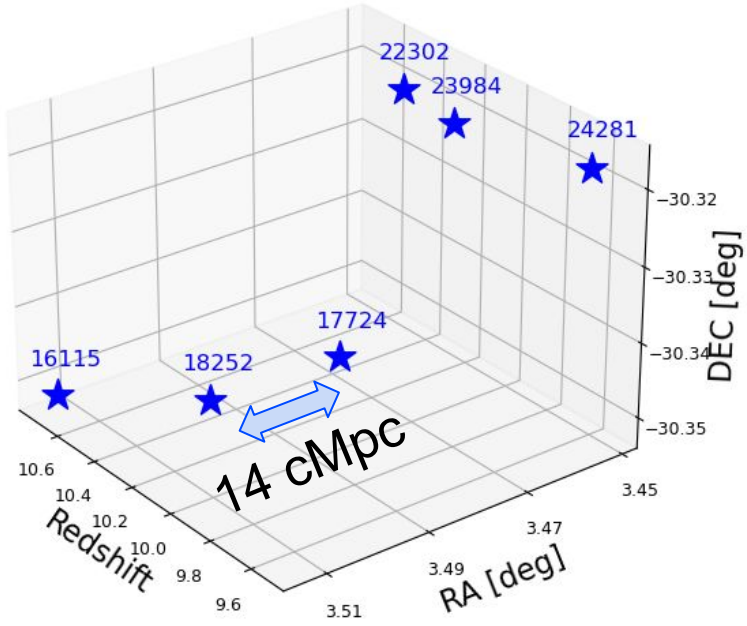
AGN diagnostics at z > 10



AGN and **SF** models by Nakajima & Maiolino 2022

Are these galaxies part of a proto-cluster at z = 10?

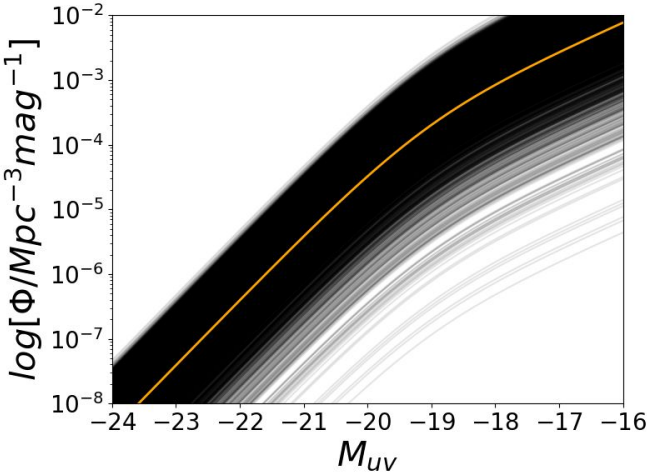




Lower-redshift proto-clusters found at z = 5.5 - 7.5
Toshikawa+12, Harikane+19, Hu+21, Morishita+23

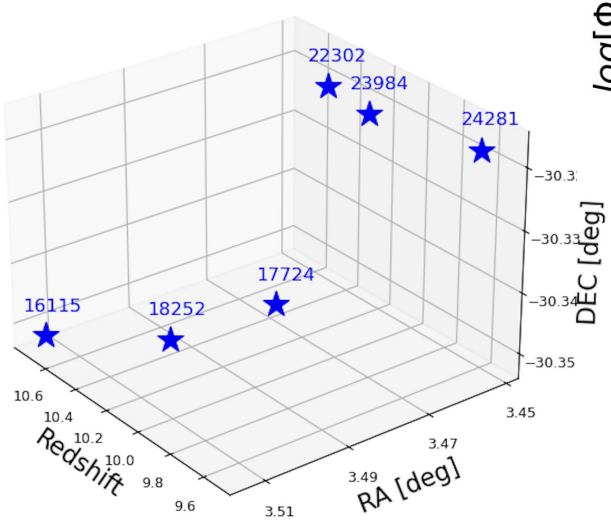
6 observed galaxies at 9.5 < z < 11 in the GLASS field

Donnan+23

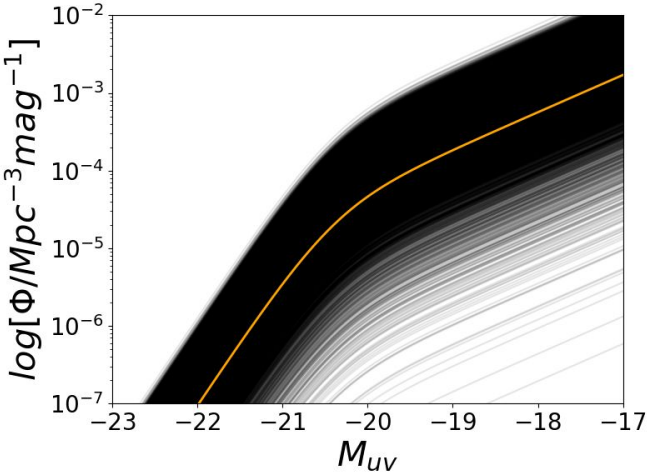


…see Callum's talk

Expected: < 7 at 2σ



Finkelstein+23



see also UV-LF results from Perez-Gonzalez+23, Harikane+24, Willott+24, McLeod+24

Summary:

1) We derived secure z_{spec} for 214 galaxies targeted by GO-3073, PI Castellano.
2) We confirm all the observed $z \geq 9.5$ candidates in the GLASS-ERS field.
3) Some sources show very high EW_0(CIII]): are these AGNs?

   → Interesting implications for the bright end of the LF.
4) These sources are not part of a proto-cluster at z = 10.

} **Napolitano et al. 2024b, in prep.**

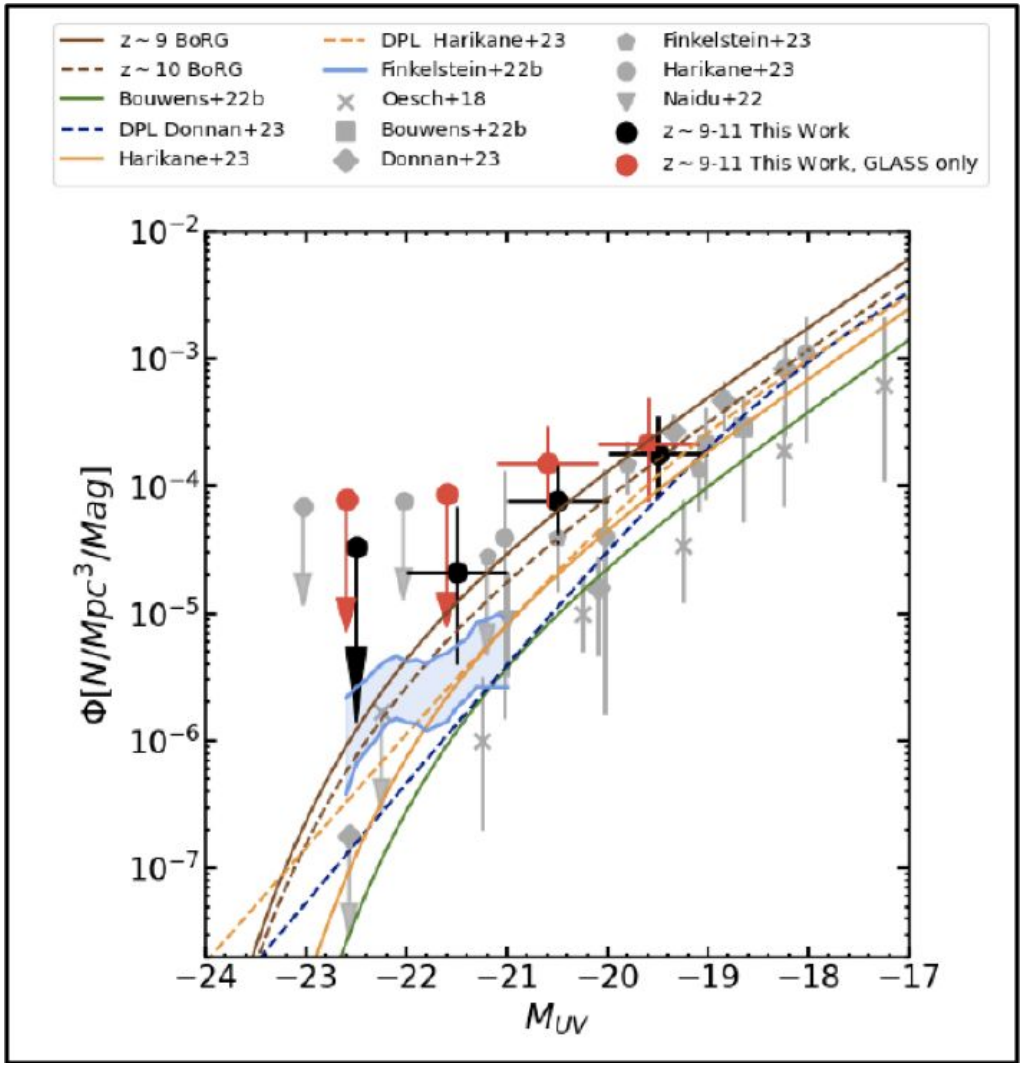
What's next:

New data (second pointing, same field) in few weeks… 28 high-priority candidates to confirm!!

Feel free to reach out: lorenzo.napolitano@inaf.it

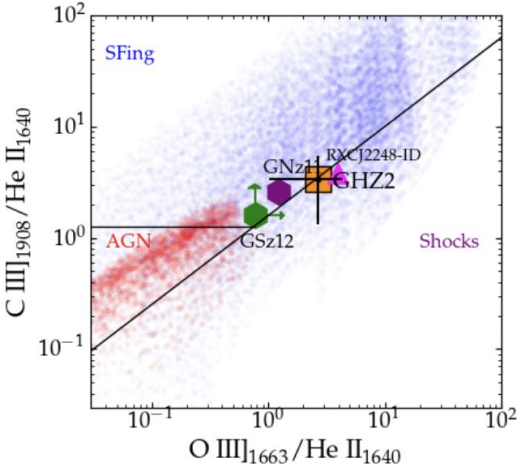
Thank you!

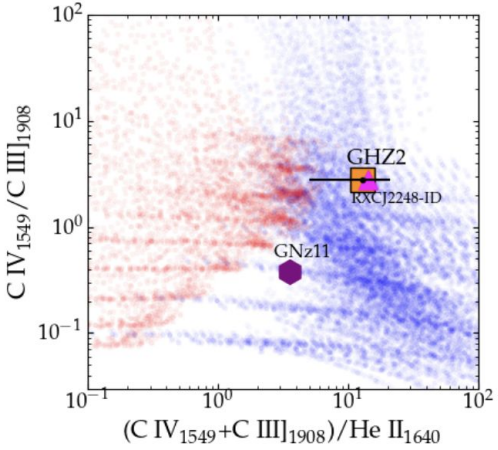
Backup slides

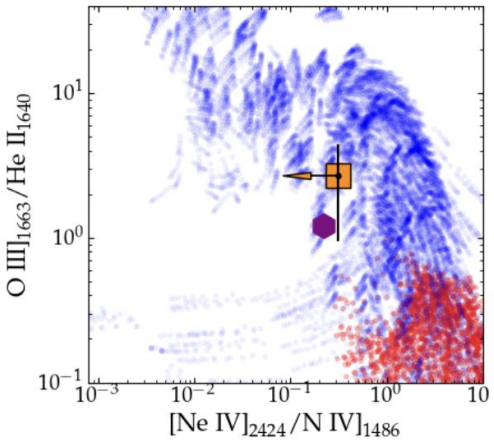


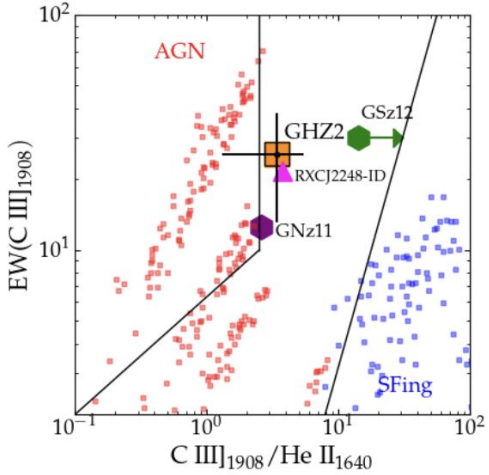
Castellano+23 result after accounting for completeness

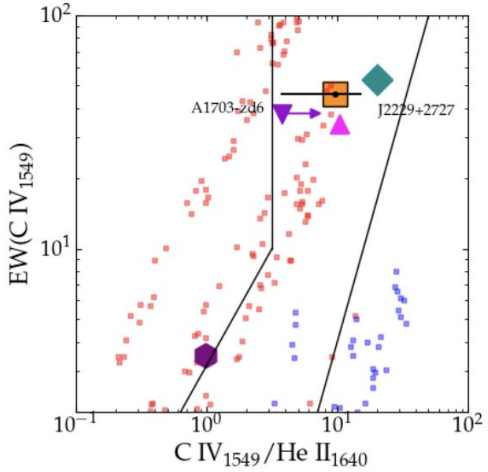
GHZ2 - AGN or Star-forming?

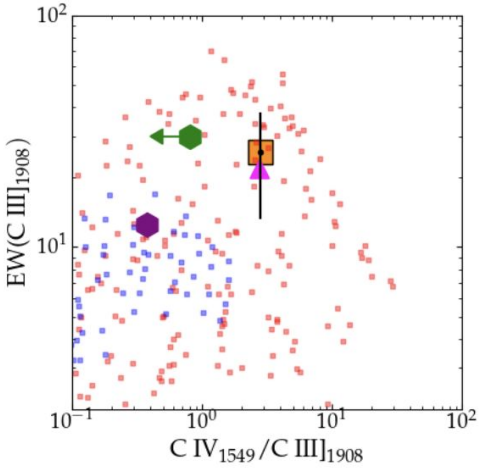


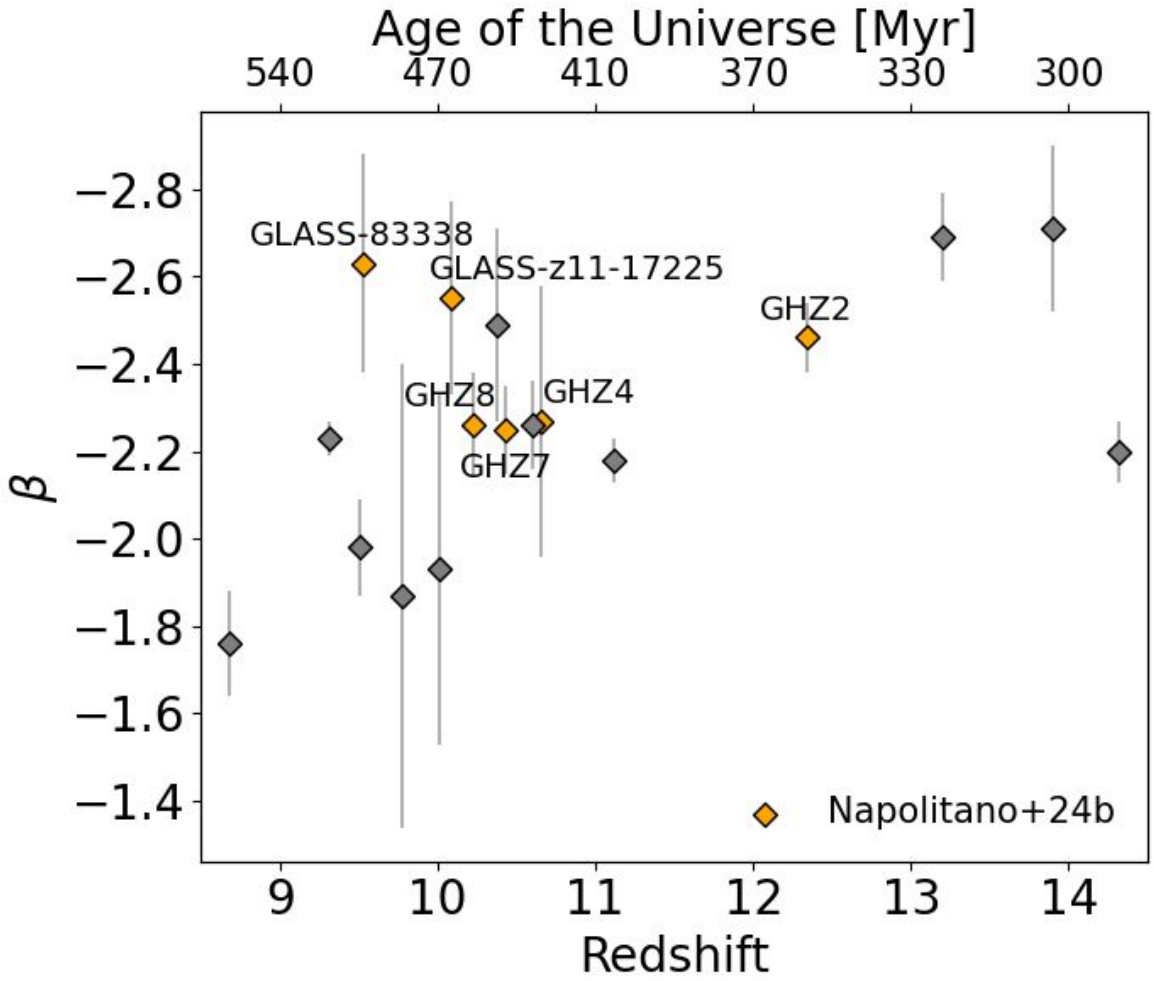












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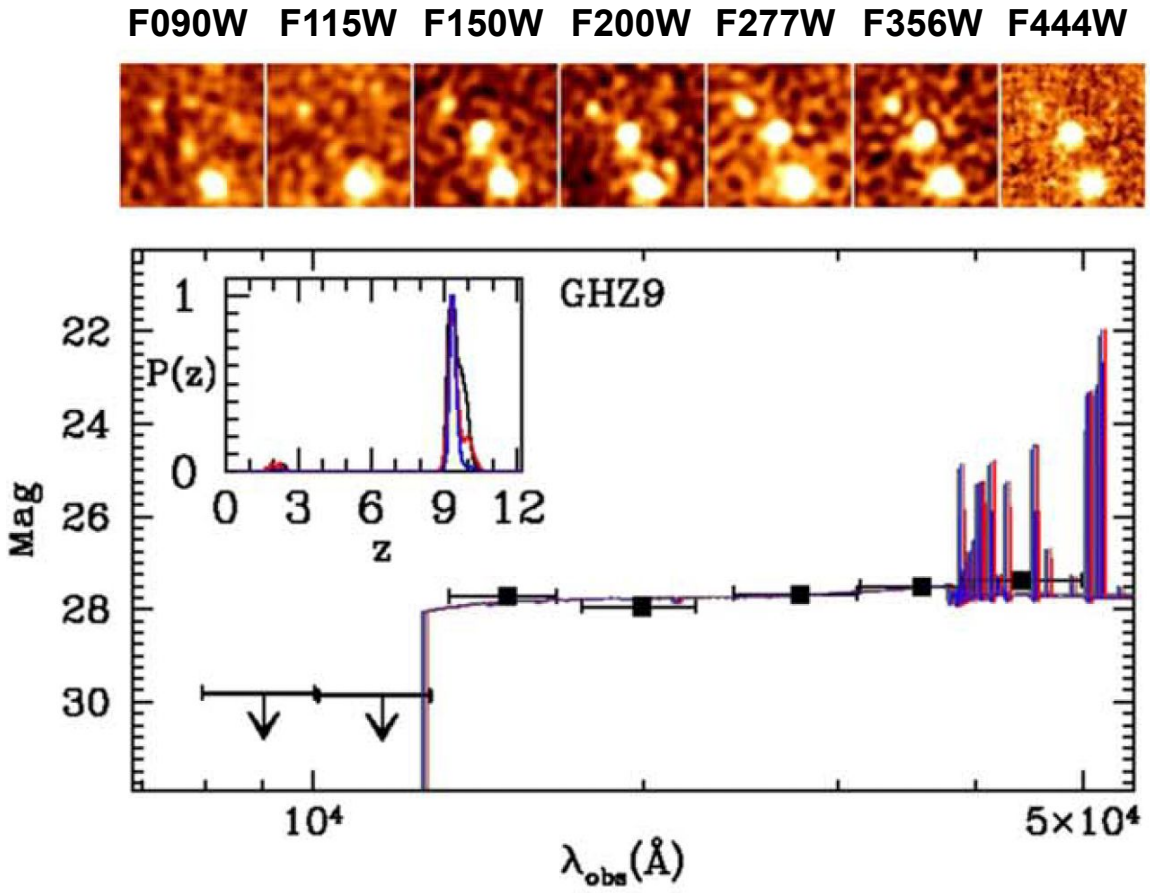
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F200W
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F356W
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GHZ9
P(z)
z
Mag
λ_{obs}(Å)
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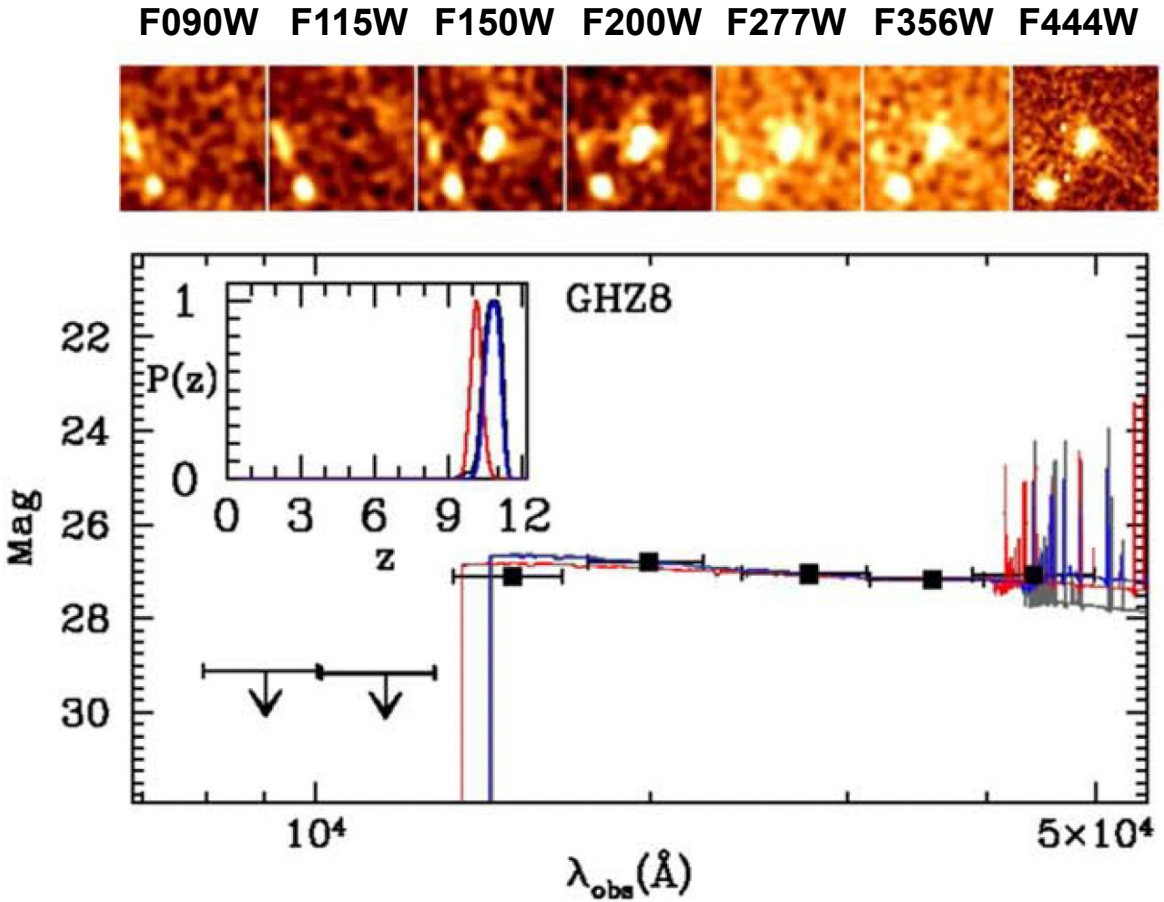
5×10^4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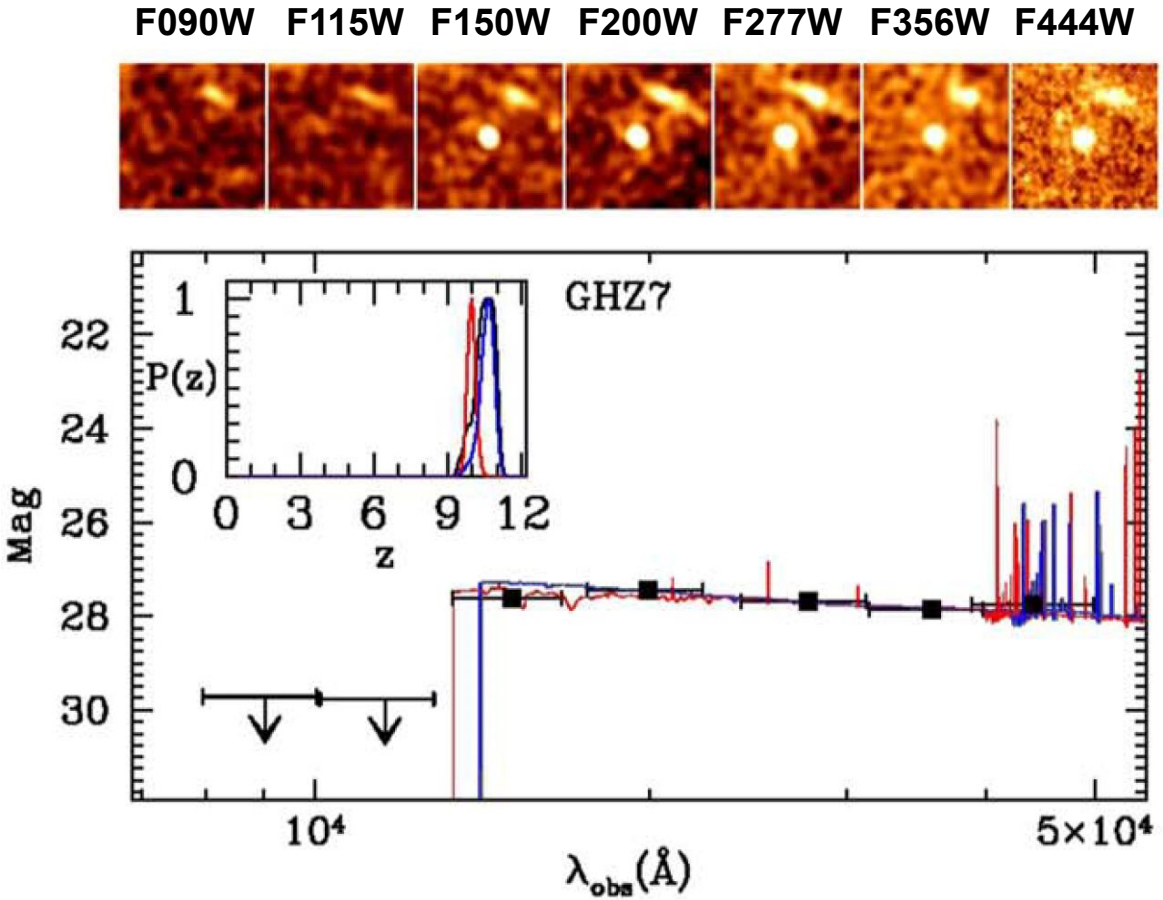
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GHZ7
P(z)
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0
0 3 6 9 12
z
Mag
22
24
26
28
30
10⁴
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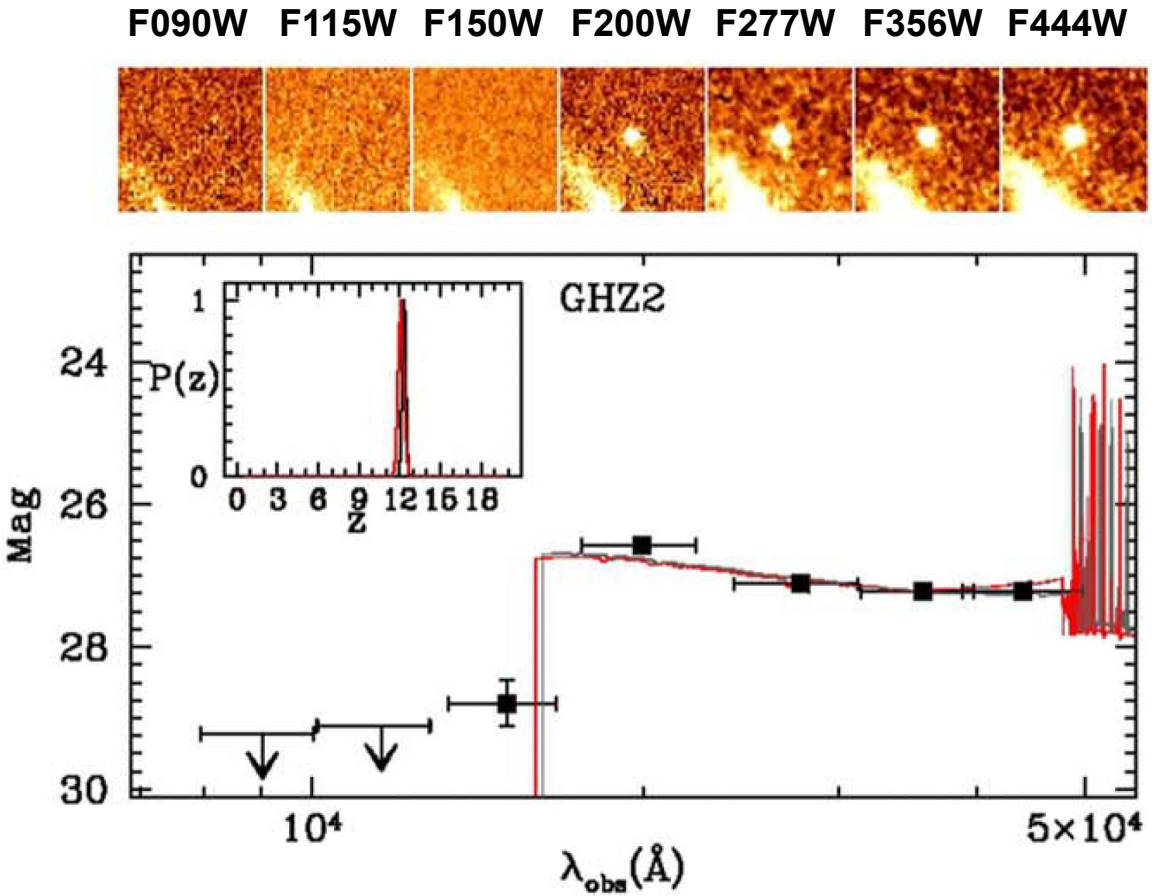
λobs(Å)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GHZ2
P(z)
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0 3 6 9 12 15 18
z
Mag
24
26
28
30
10⁴
5×10⁴
λobs(Å)