



Exploring the environments of SMGs using
narrowband observations

Thomas Cornish (He/Him)

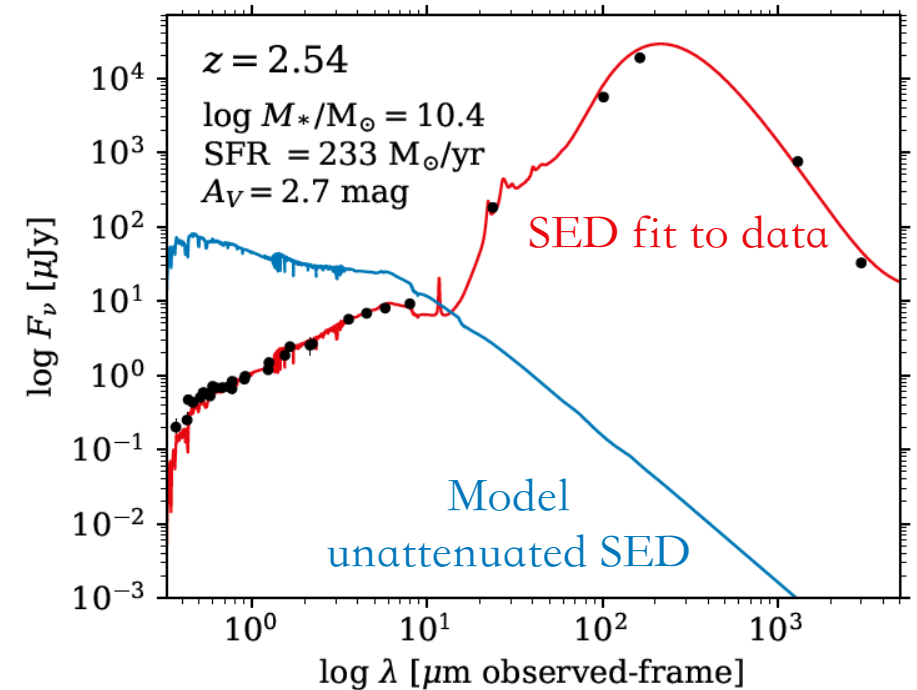
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Motivation

- Submillimetre galaxies (SMGs):
 - dusty, star-forming galaxies at high- z
 - extremely high SFRs
 - extremely IR-luminous.
- Studying their environments can provide insight into their evolution.
- This study: in what environments do SMGs typically reside?

An example SMG SED.

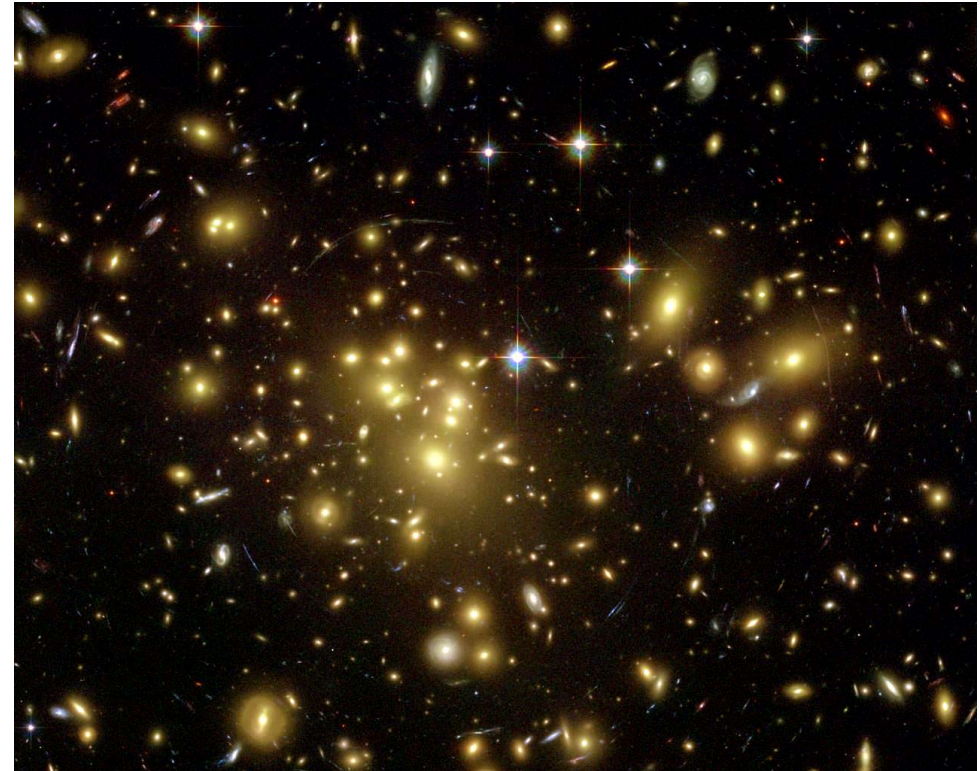


Aravena+2020

SMGs: Early-Type Galaxy Progenitors?

- Local early-type galaxies are...
 - massive
 - thought to have formed most of their stellar content in short bursts before $z \sim 2$
 - typically found in galaxy clusters.

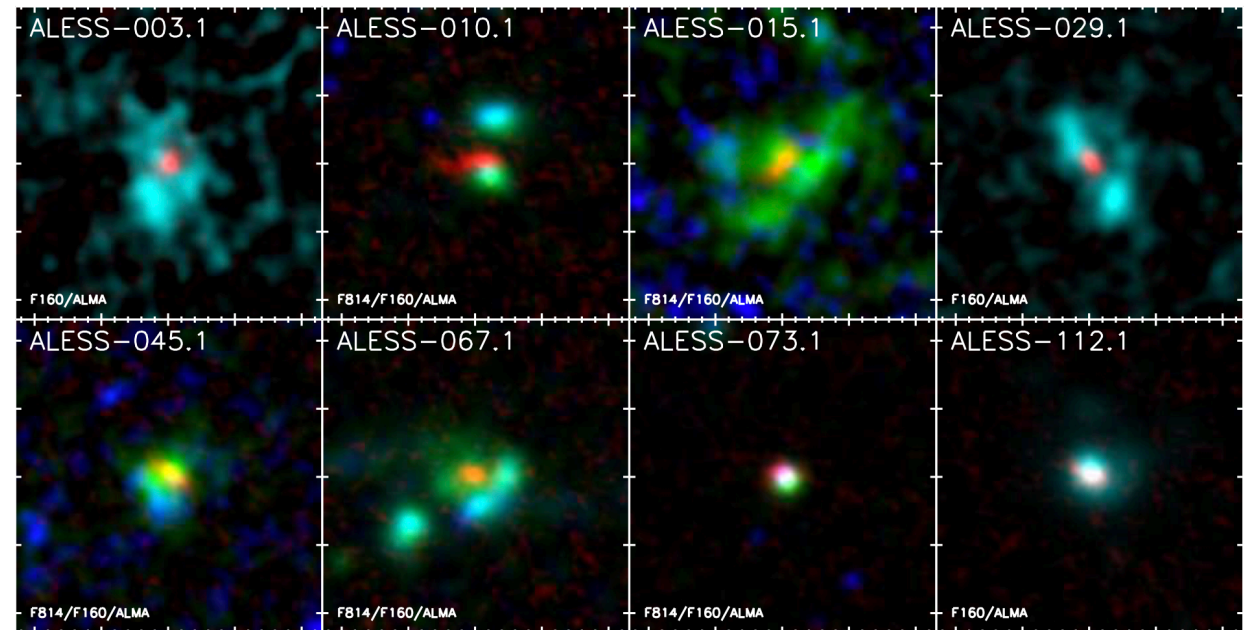
The galaxy cluster Abell 1689.



SMGs: Early-Type Galaxy Progenitors?

- SMGs are...
 - massive
 - undergoing intense bursts of star formation at a median redshift of $z \sim 2-2.5$
 - typically found in ??? environments.

False colour images of various SMGs.



Red: $870 \mu\text{m}$ Green: I_{814} Blue: H_{160}

Hodge+2016

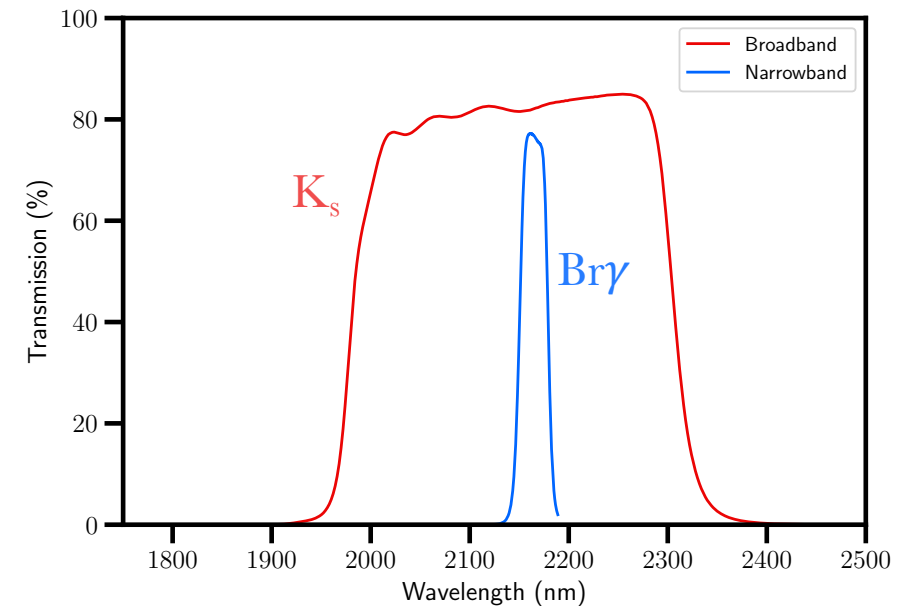
SMG Environments: What Do We Know?

- Clustering measurements suggest SMGs typically reside in overdense regions, but...
 - many of these are uncertain, being largely dependent on photo-zs
 - difficult to obtain uniform coverage e.g. with ALMA
 - provides a picture of the SMG population as a whole, rather than individual cases.
(e.g. Hickox+2012, Wilkinson+2017)
- SMGs have been observed in protoclusters, but...
 - existing SMG samples are inherently biased towards overdense environments.
(e.g. Casey+2015, Oteo+2018)

This Study

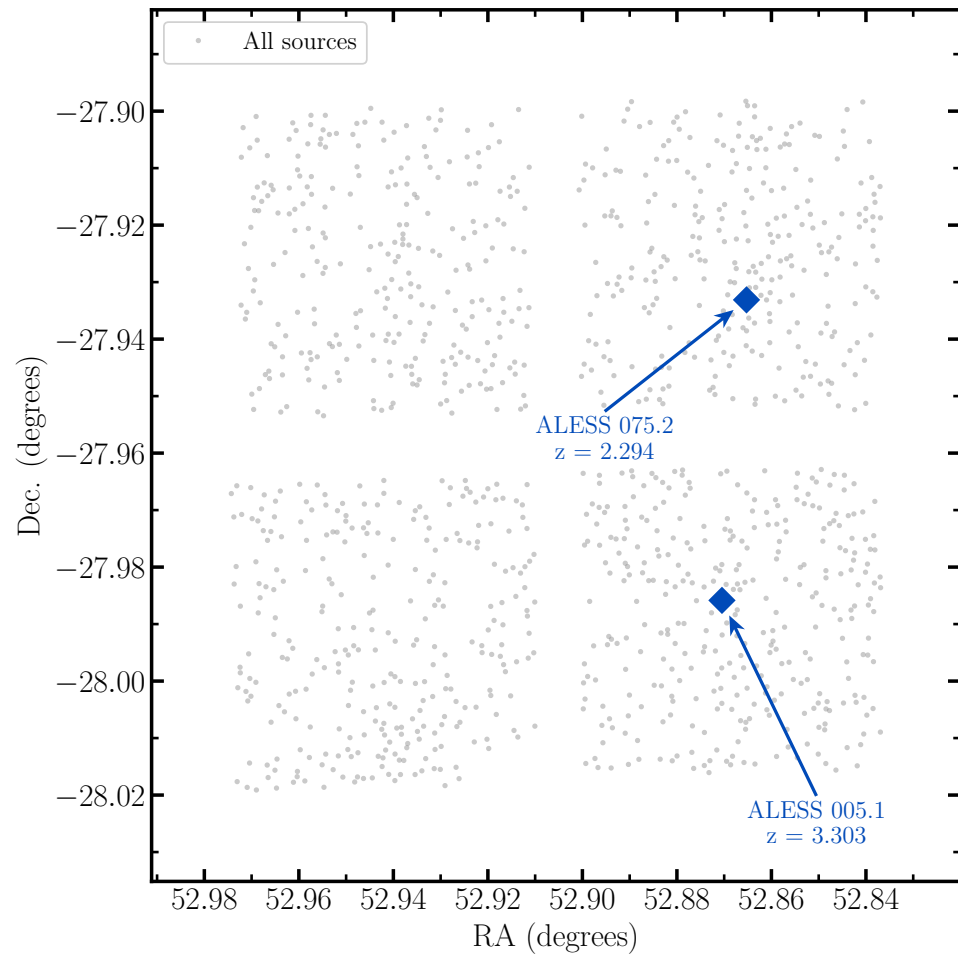
- ALESS: ALMA follow-up to the LABOCA ECDFS Submillimetre Survey (LESS)
 - produced a catalogue of 131 SMGs, many of which now have spec-zs.
- 6 ALESS SMGs were chosen for observing with VLT/HAWK-I based only on their redshifts
 - H α ([OIII]) line shifts into HAWK-I Br γ coverage at $z = 2.3$ (3.3).
- Only 3 were observed, in two 7.5' \times 7.5' pointings:
 - ALESS 005.1 ($z = 3.303$)
 - ALESS 075.2 ($z = 2.294$)
 - ALESS 102.1 ($z = 2.296$).

The photometric filters used for this study.

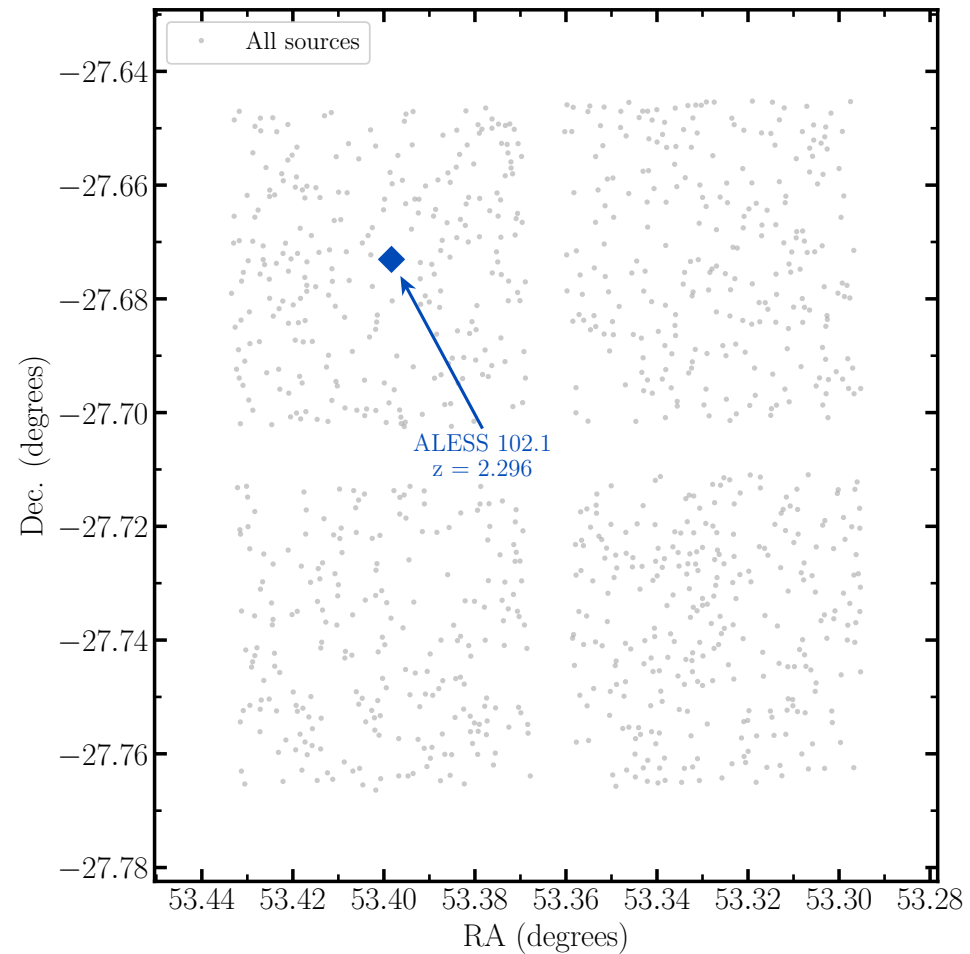


HAWK-I Pointings

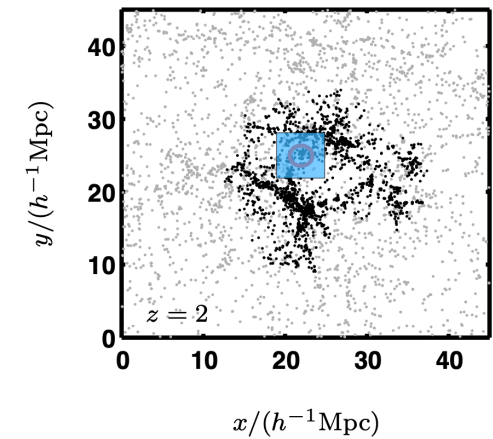
Pointing 1



Pointing 2



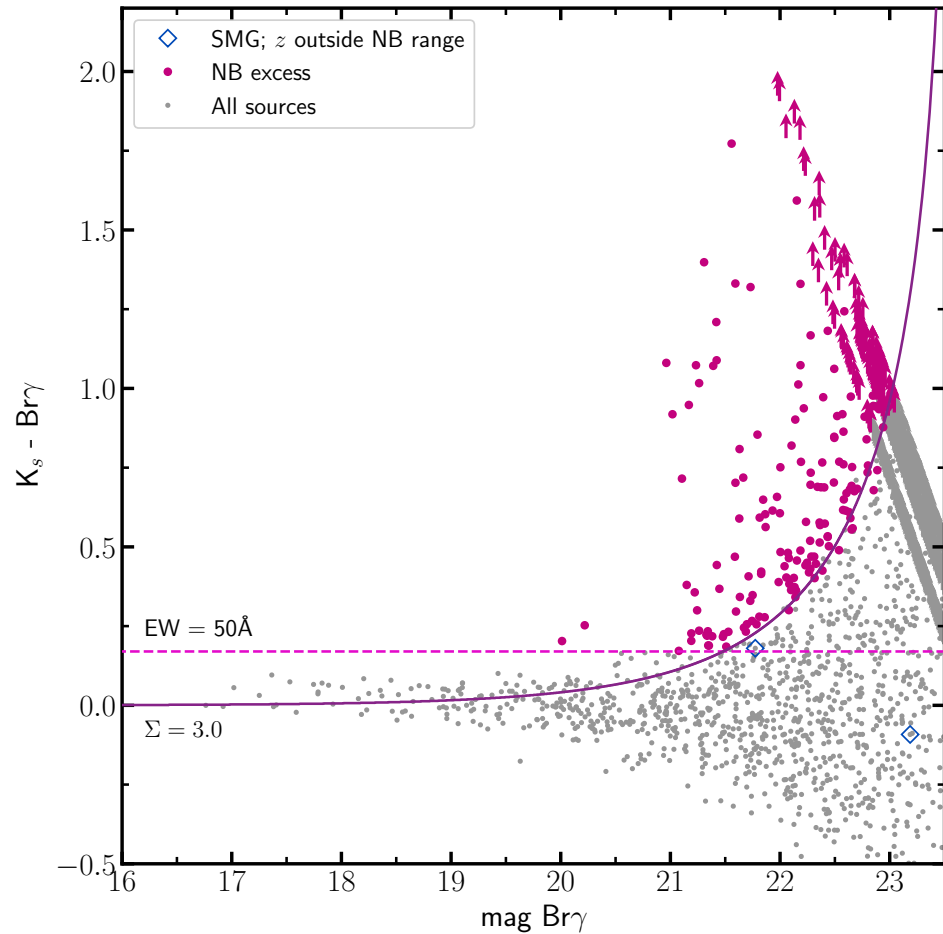
A simulated
protocluster at $z = 2$



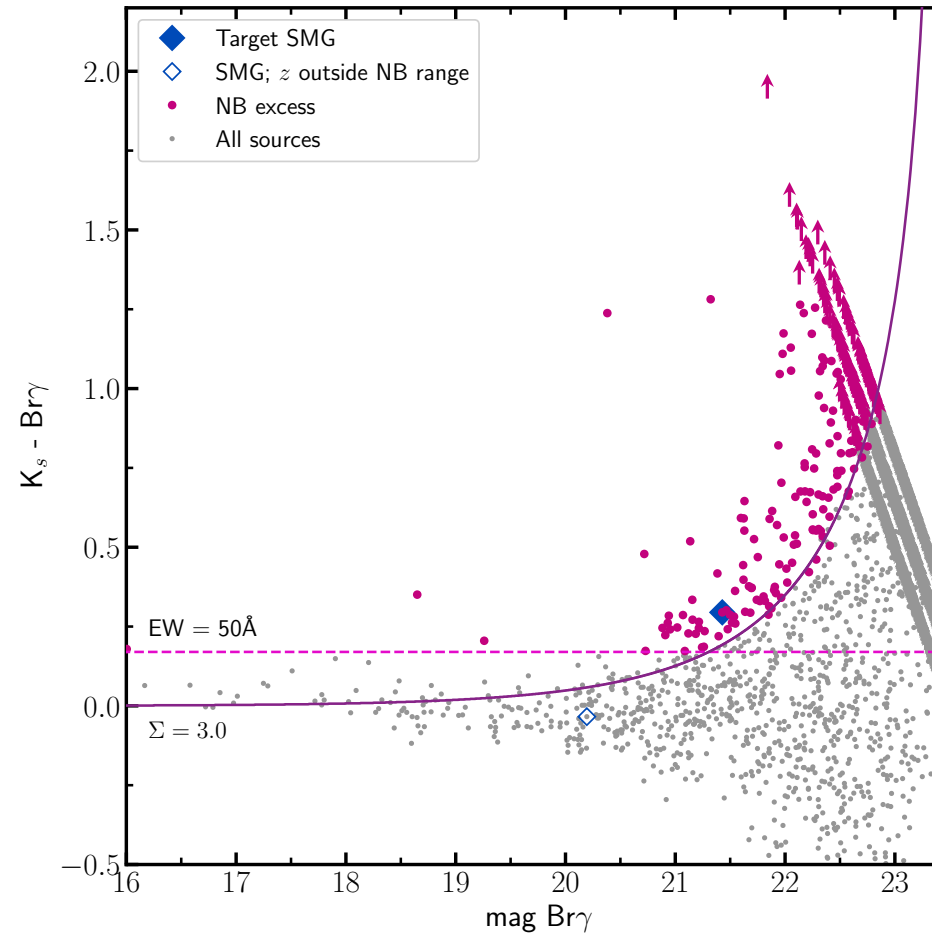
Muldrew+2015

Candidate NB Emitters: Colour-Magnitude Diagrams

Pointing 1



Pointing 2



Method: cf. e.g.
Bunker+1995,
Geach+2008,
Sobral+2013.

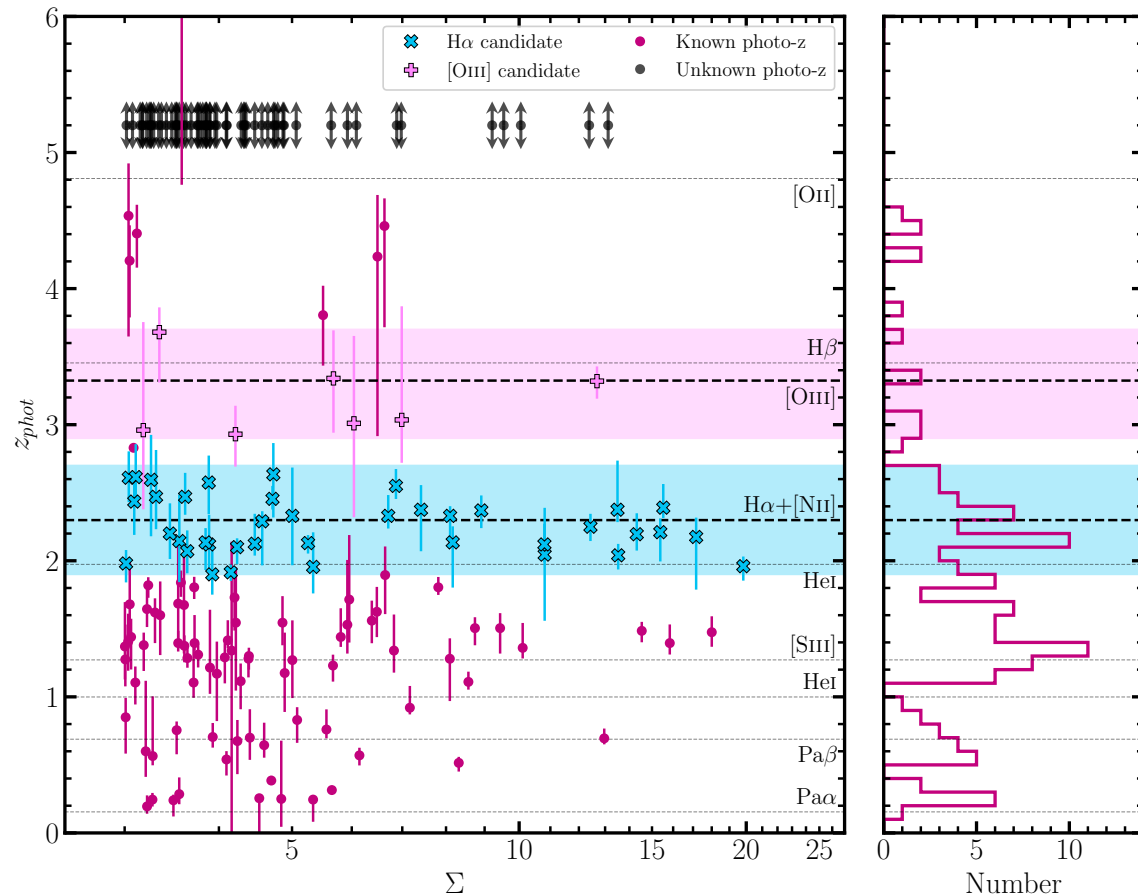
Candidate NB Emitters: Redshifts

- So far, had only identified candidate line emitters in general
 - these could include several possible lines at various redshifts.
- Needed to identify any line emitters at the same redshifts as the SMGs
 - i.e. are they $H\alpha$ ([OIII]) emitters at $z = 2.3(3.3)$?
- Done by cross-matching our data with a reference catalogue which contains multiband photometry and photo-zs across the entire ECDFS.

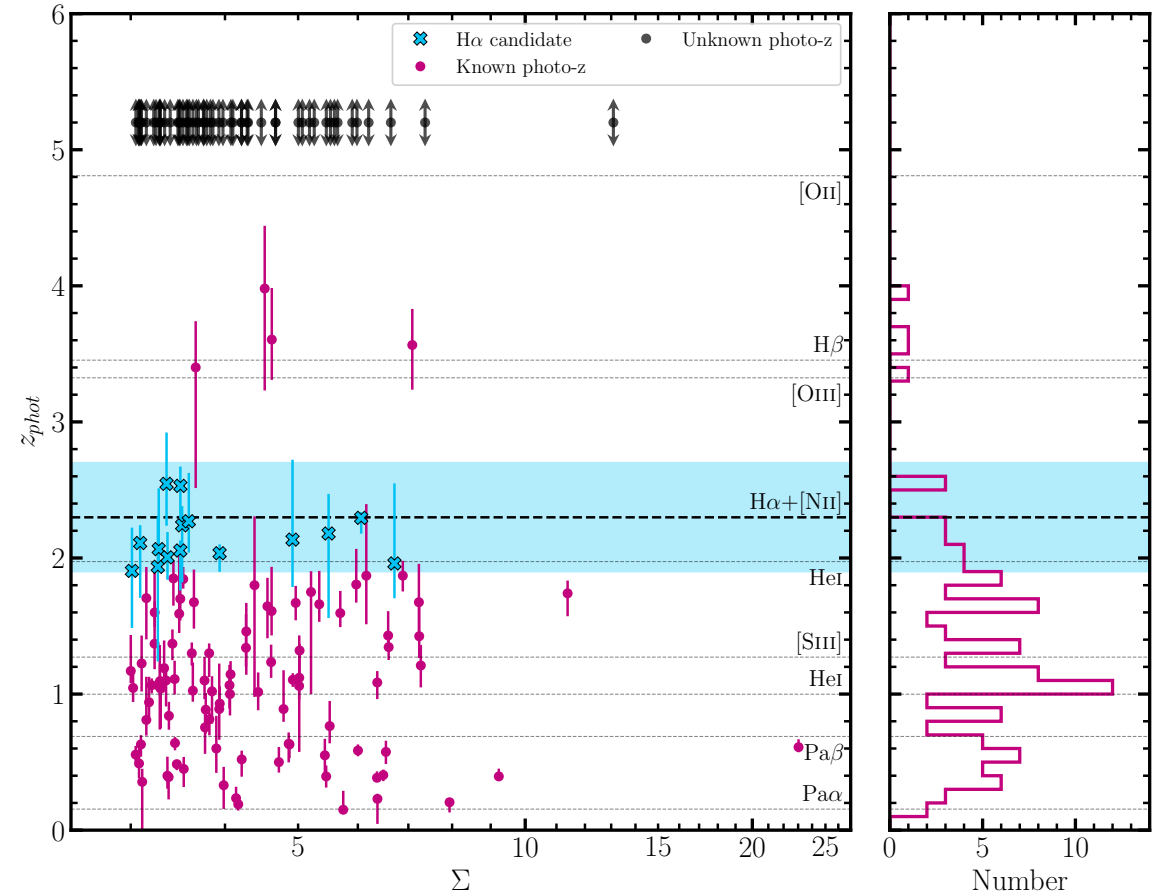
(photo-zs: Simpson+2014)

Candidate NB Emitters: Redshifts

Pointing 1

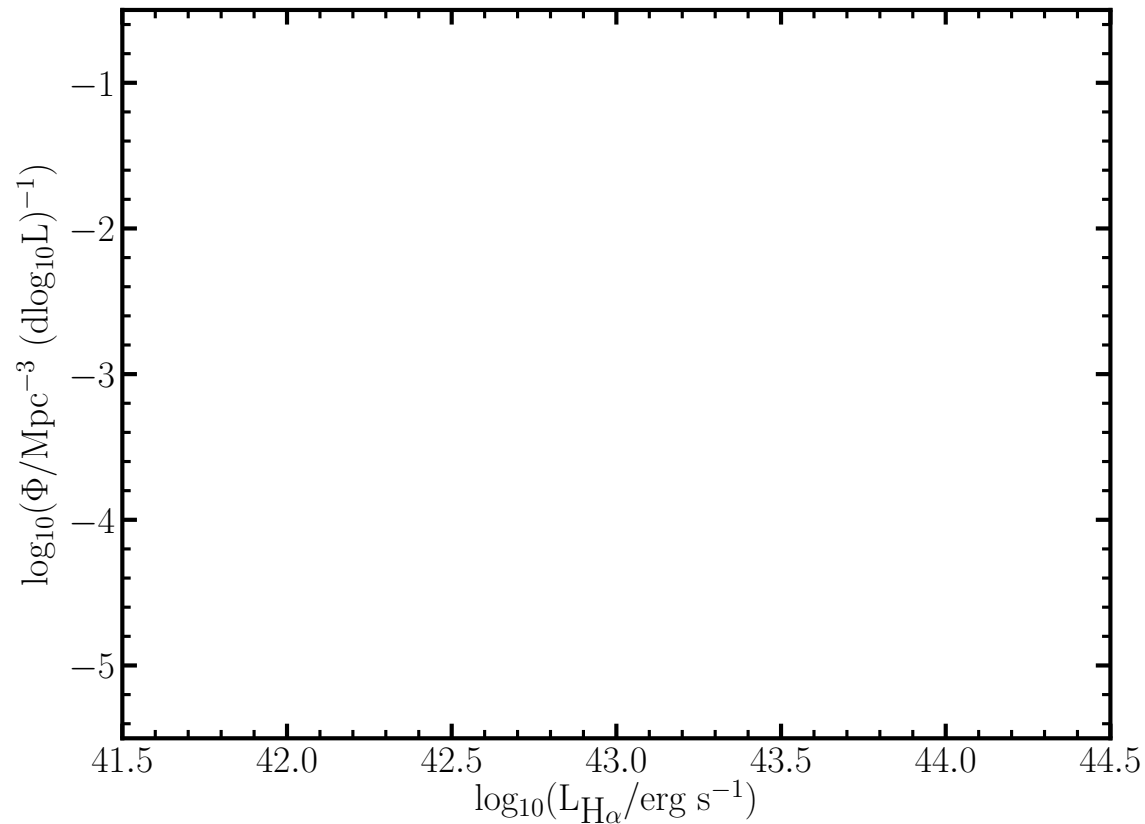


Pointing 2

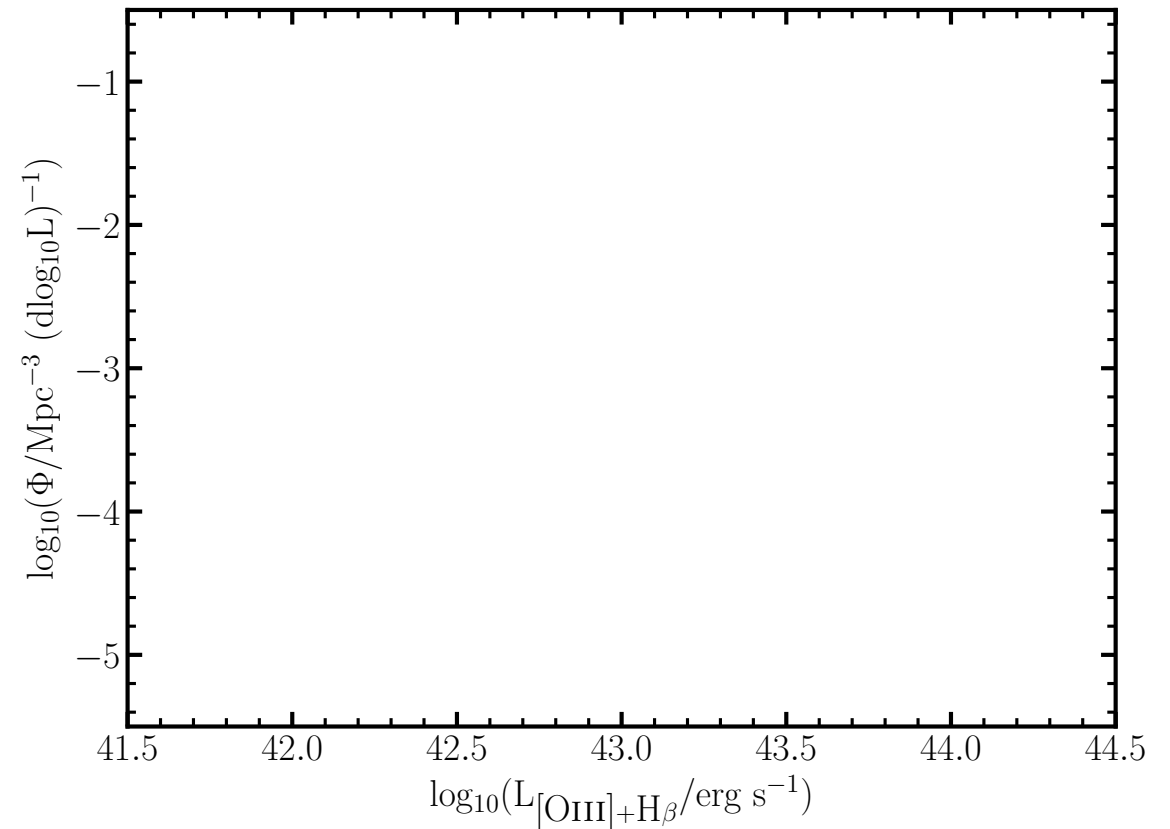


(Preliminary) Luminosity Functions

H α (corrected for [NII])

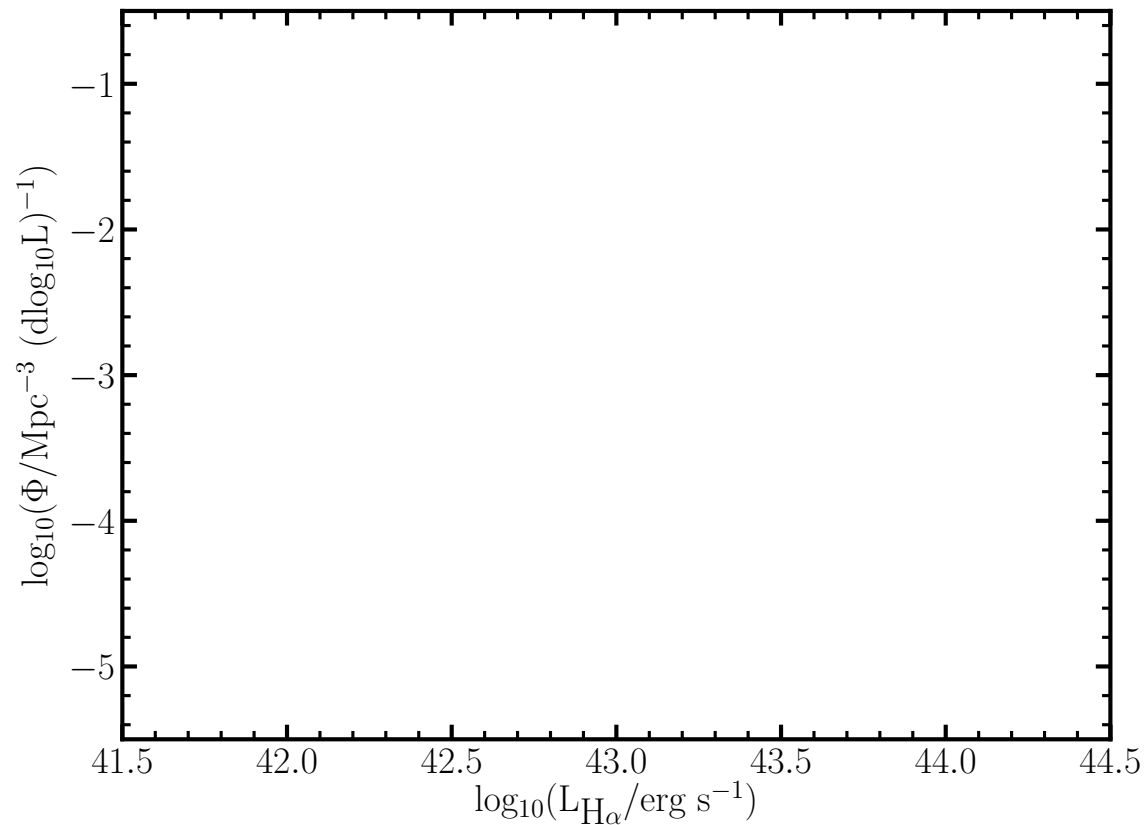


[OIII] (+ H β)

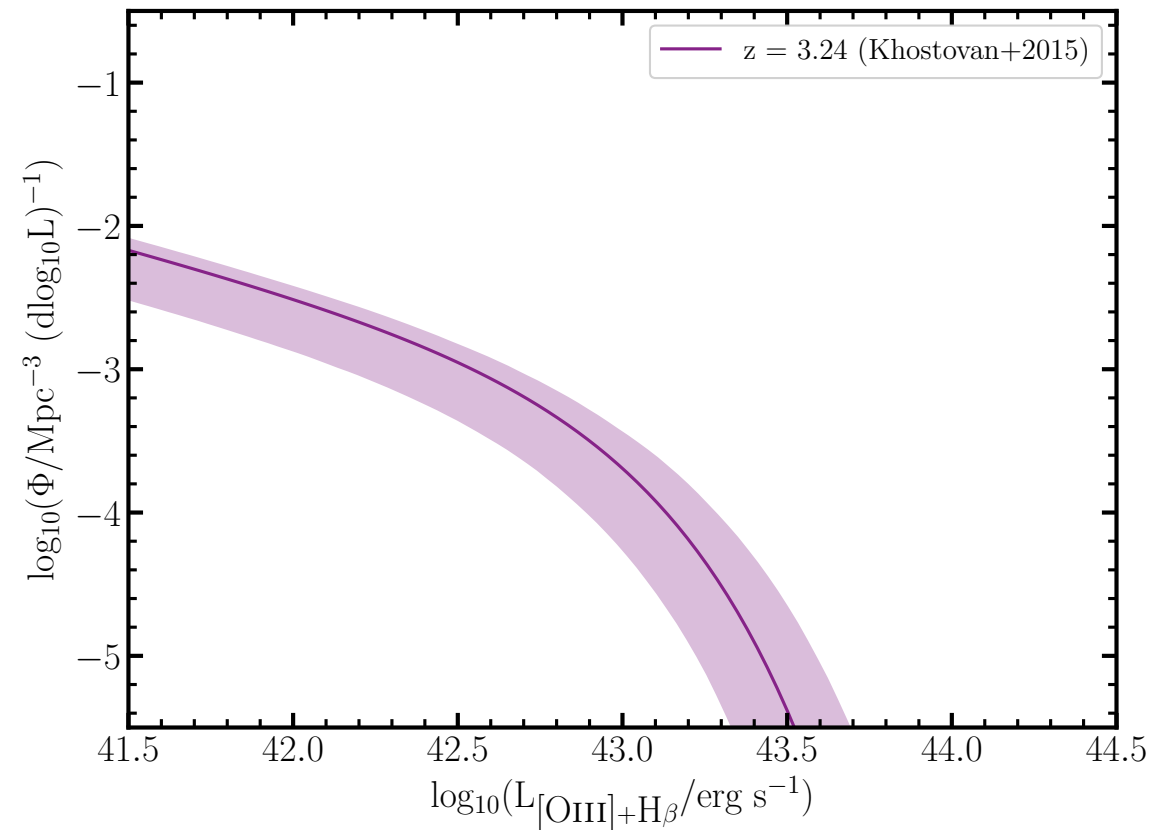


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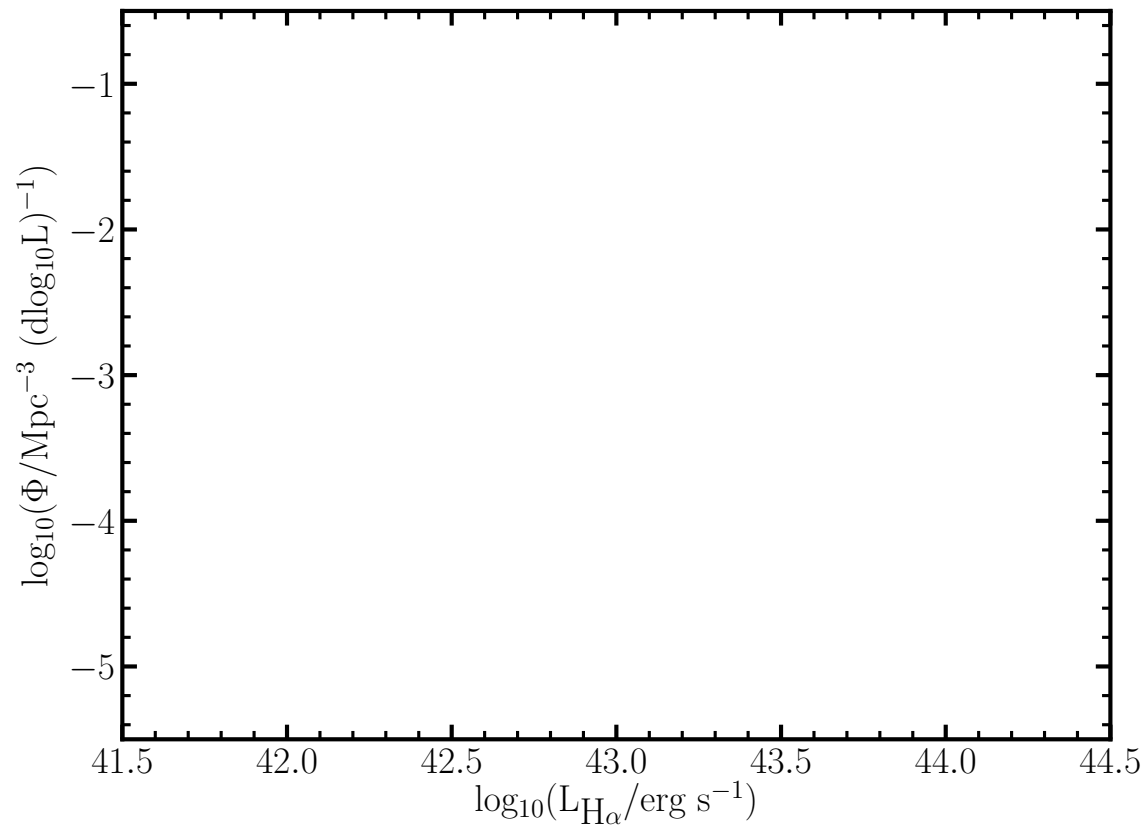


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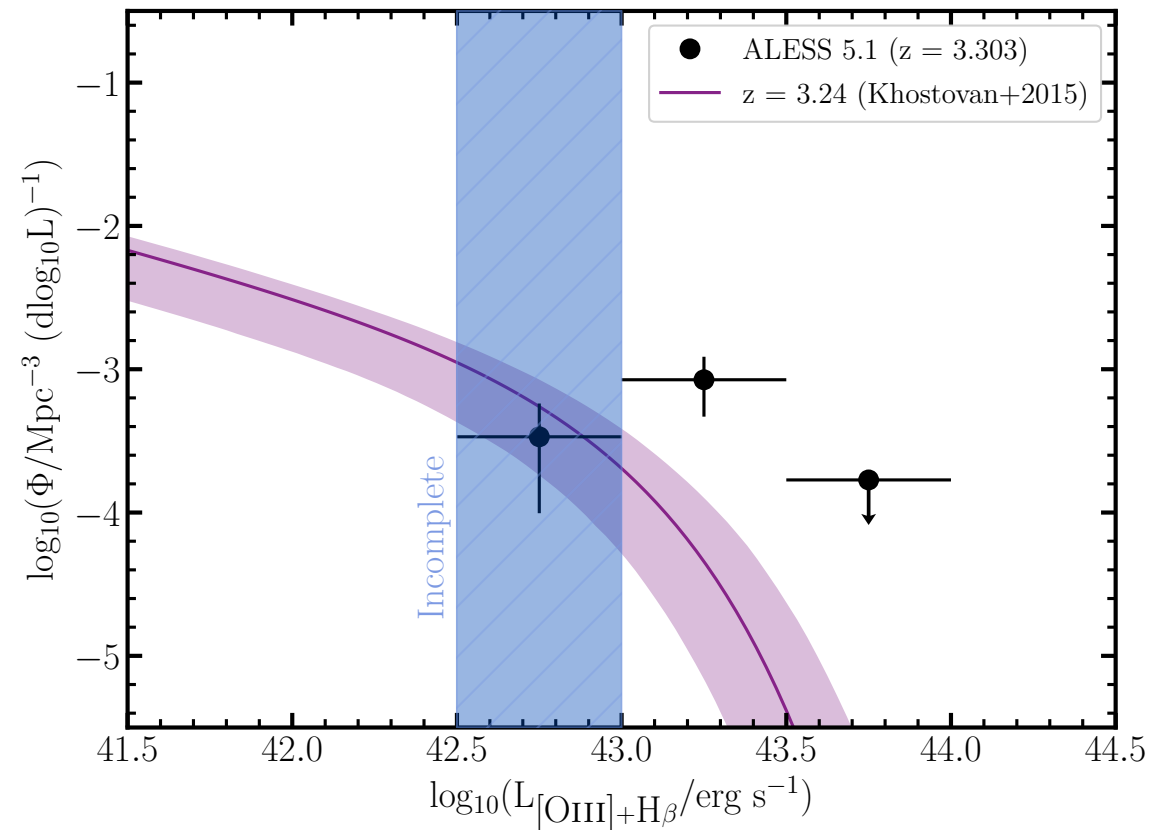


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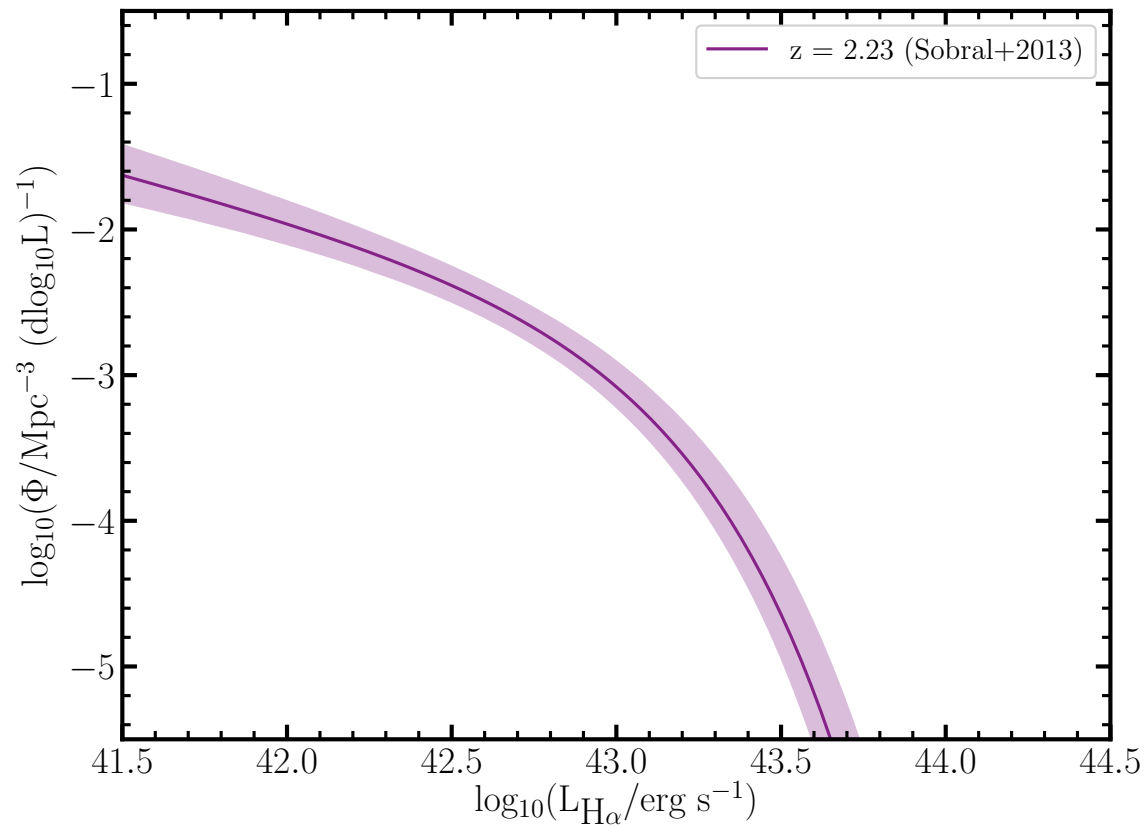


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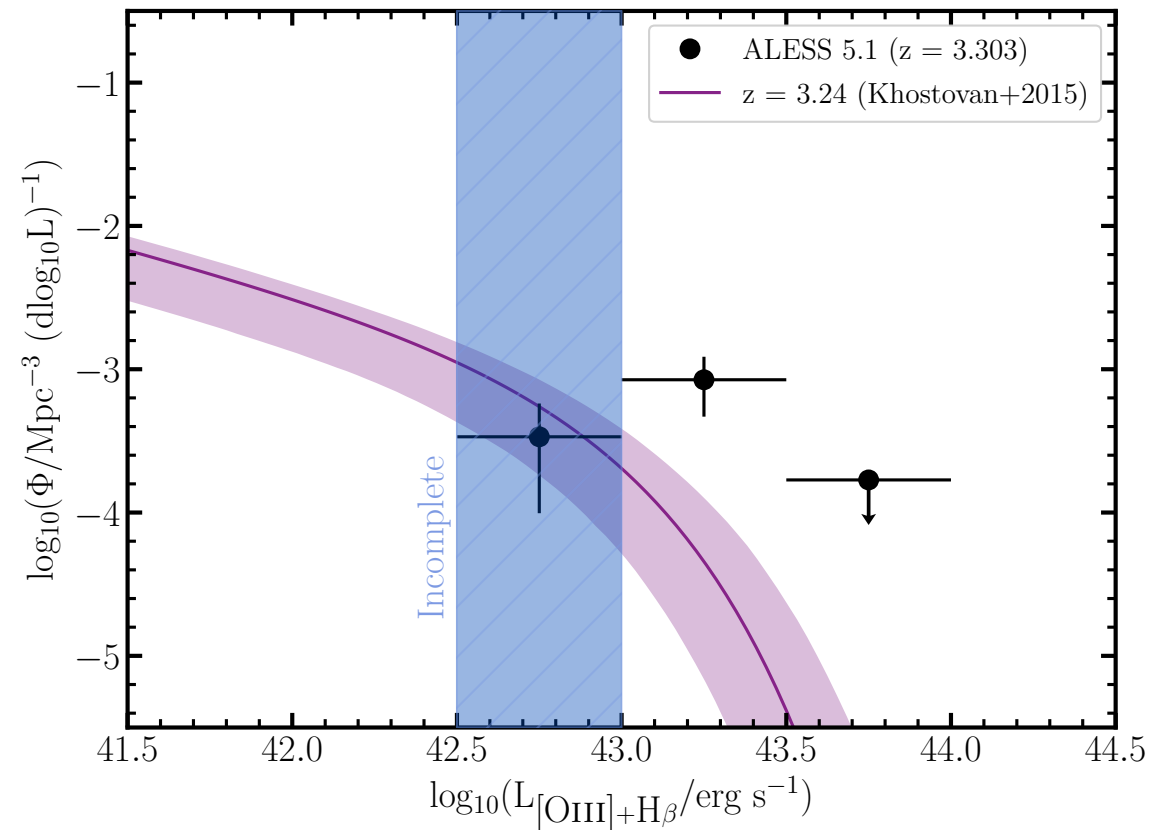


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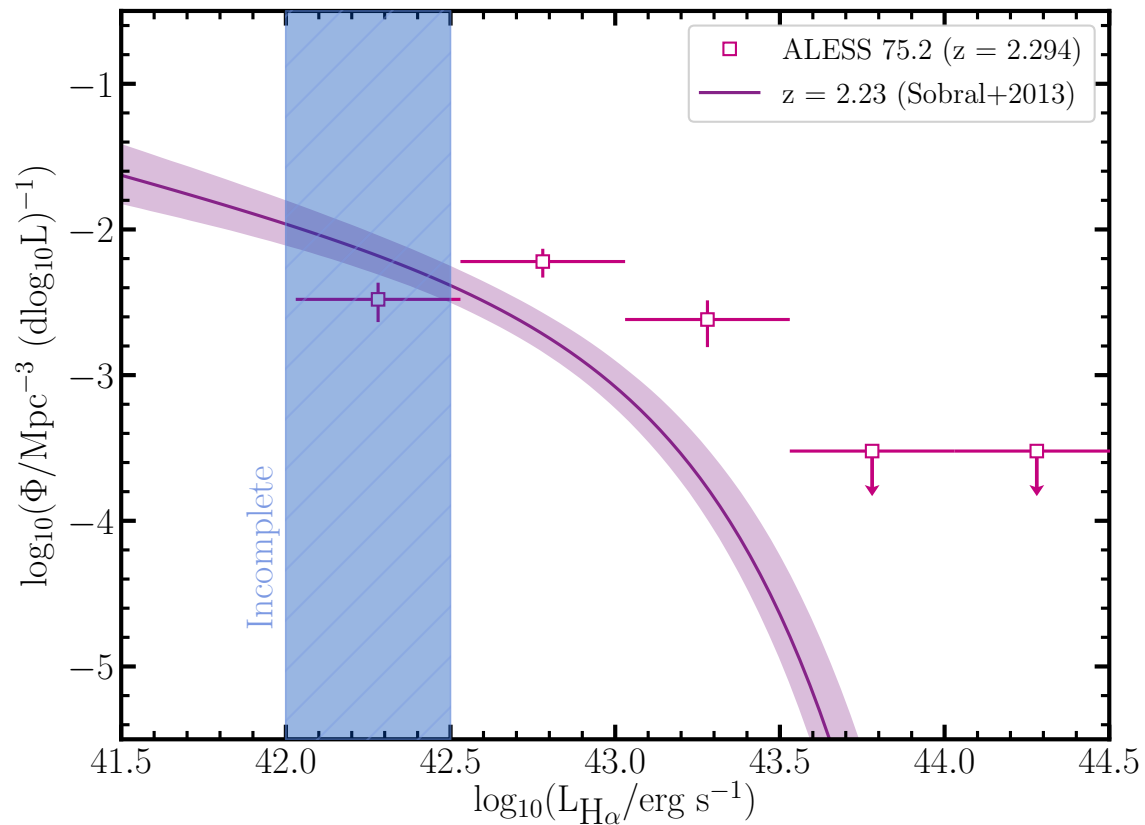


[OIII] (+ H β)

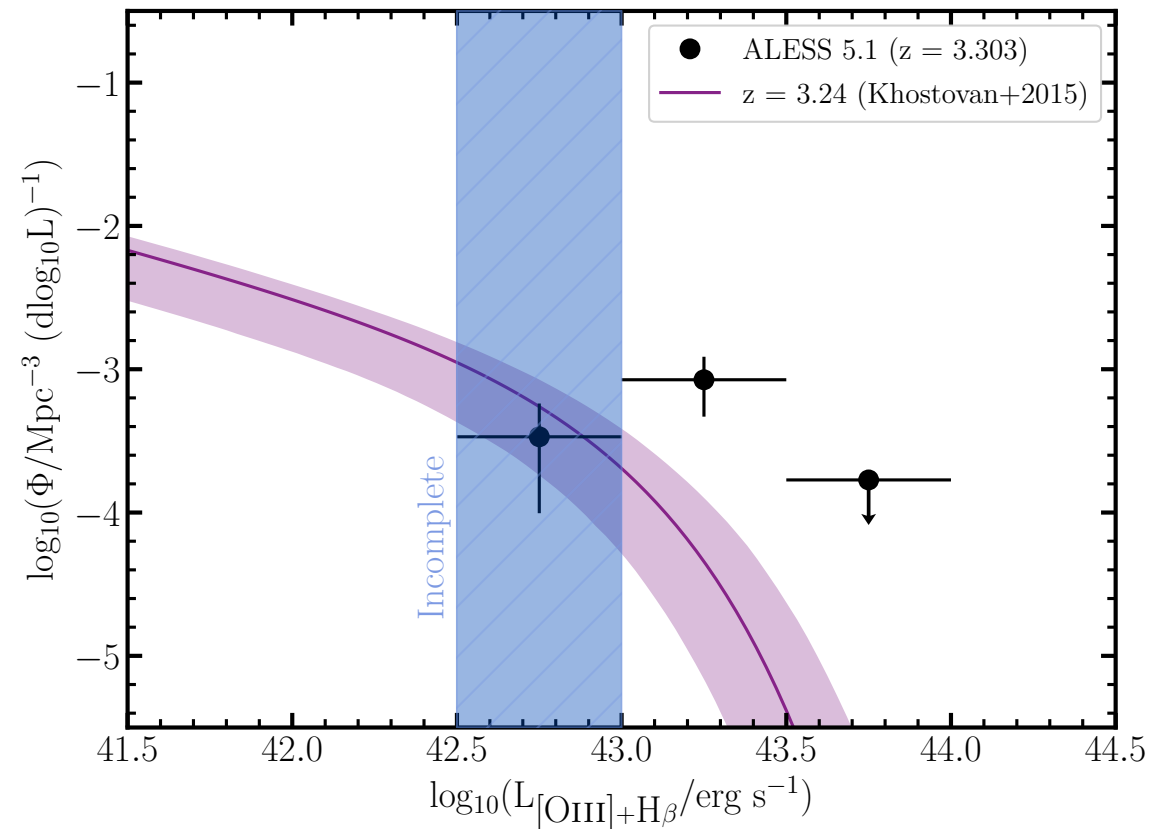


(Preliminary) Luminosity Functions

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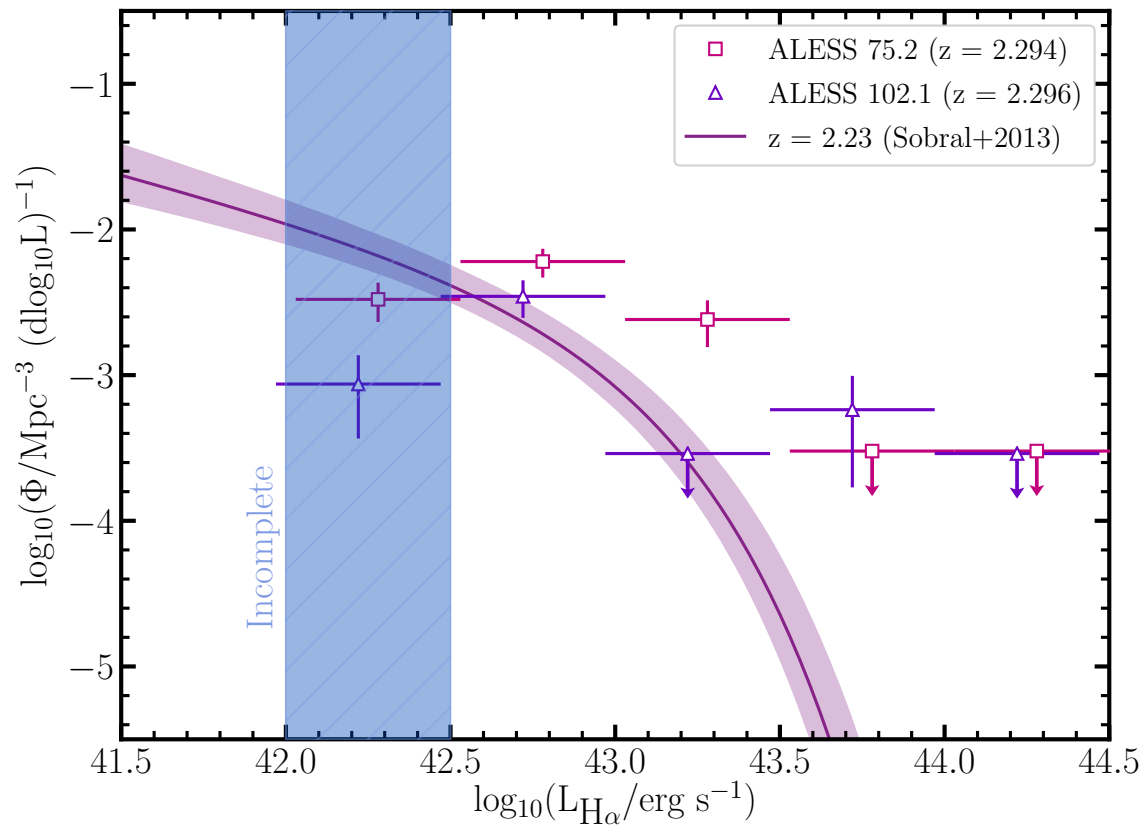


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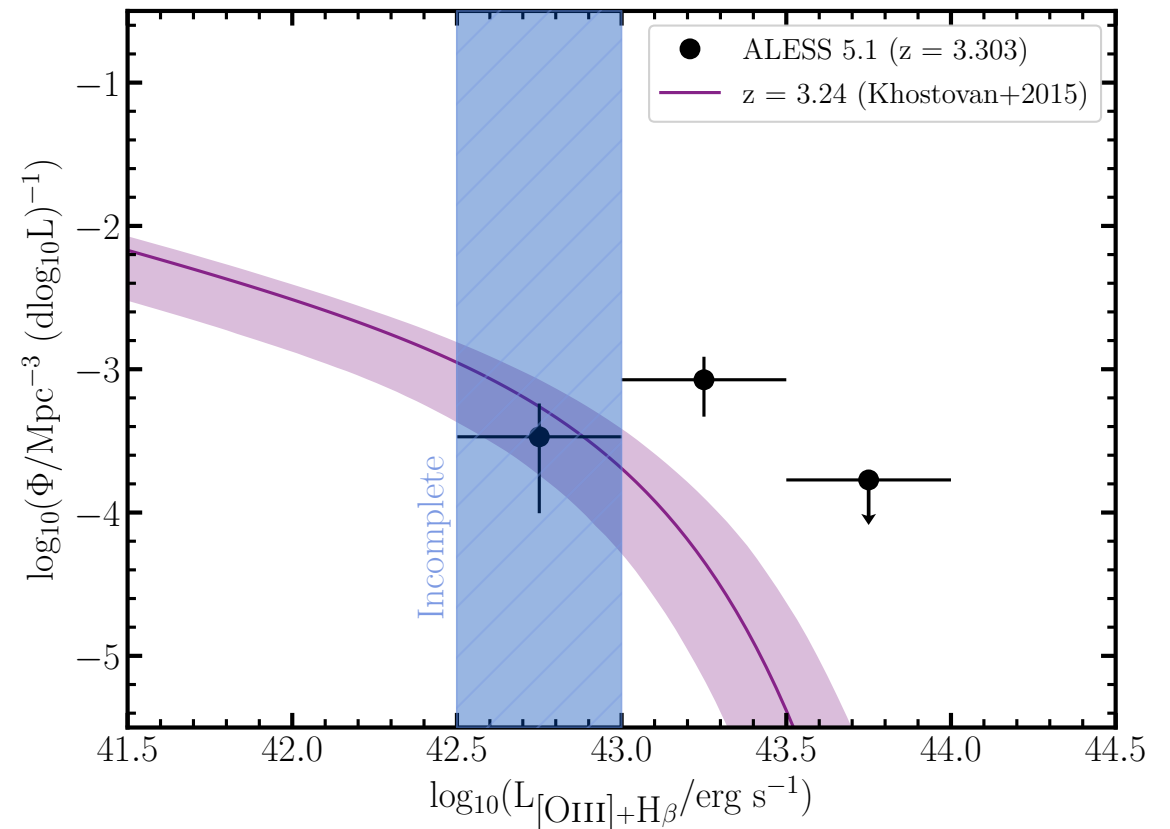


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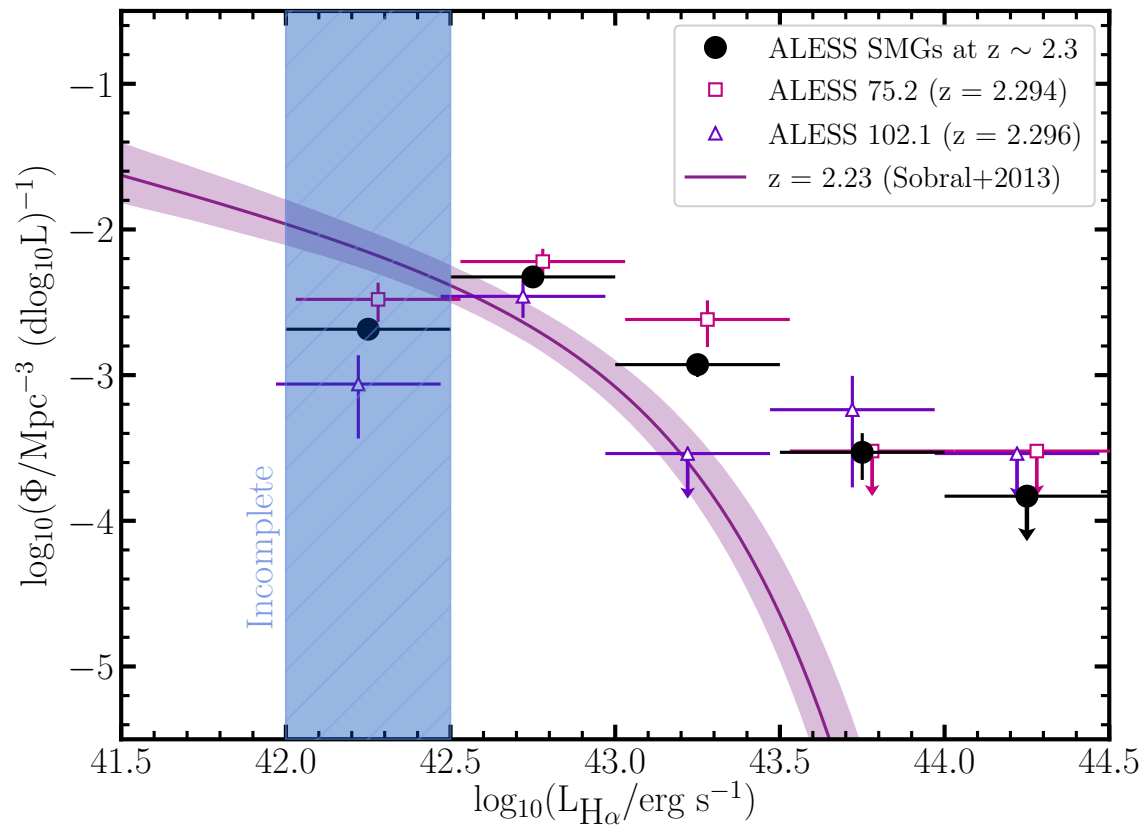


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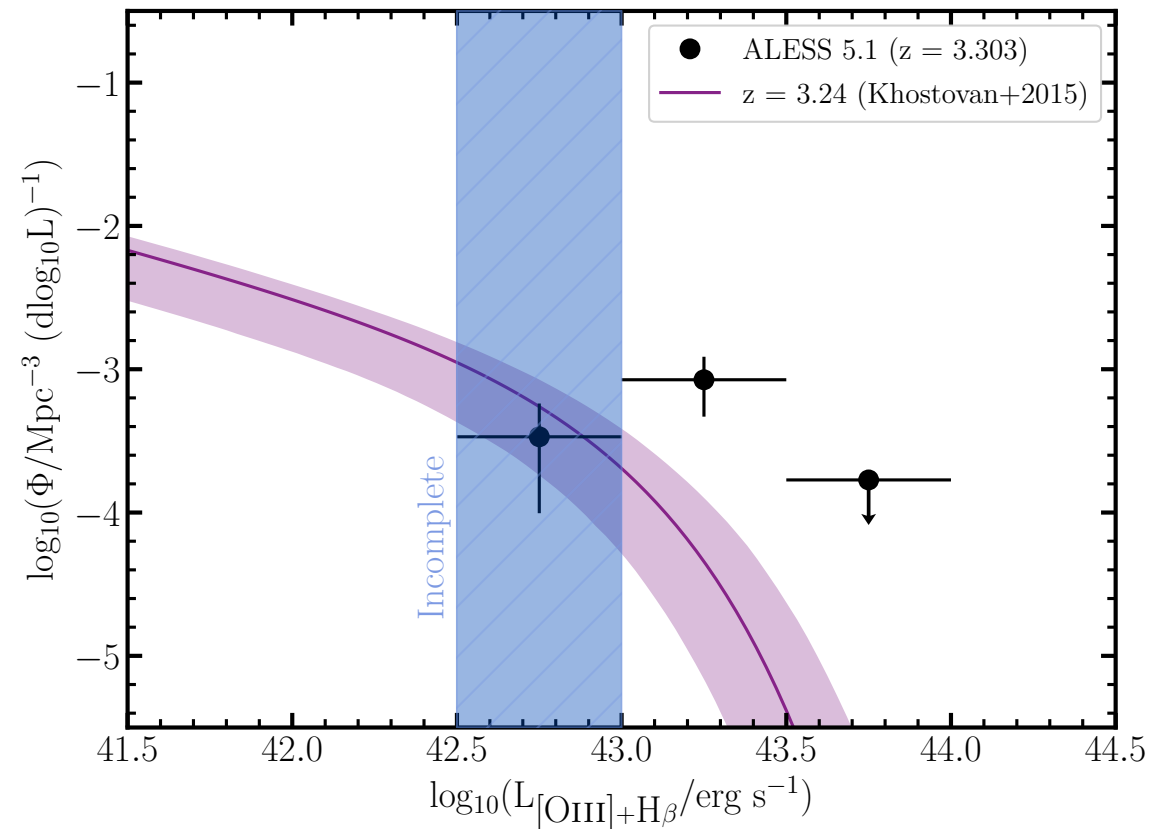


(Preliminary) Luminosity Functions

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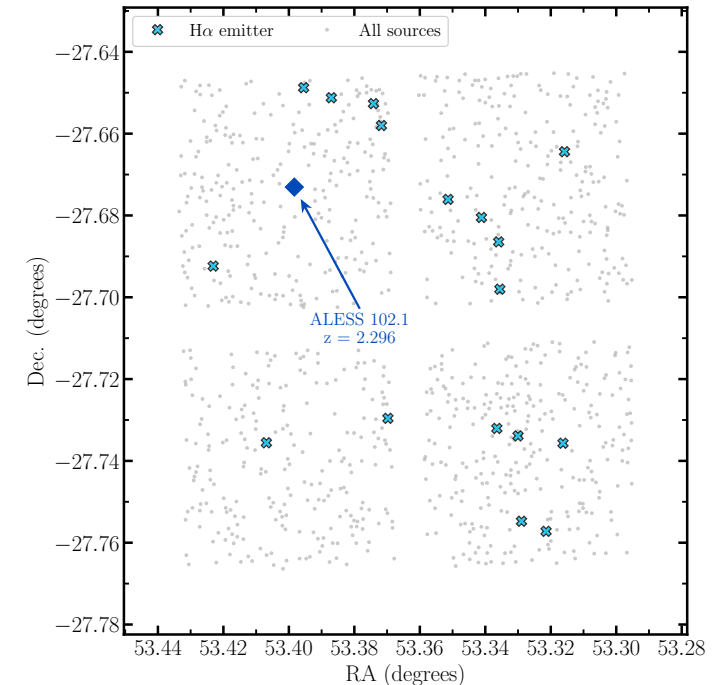
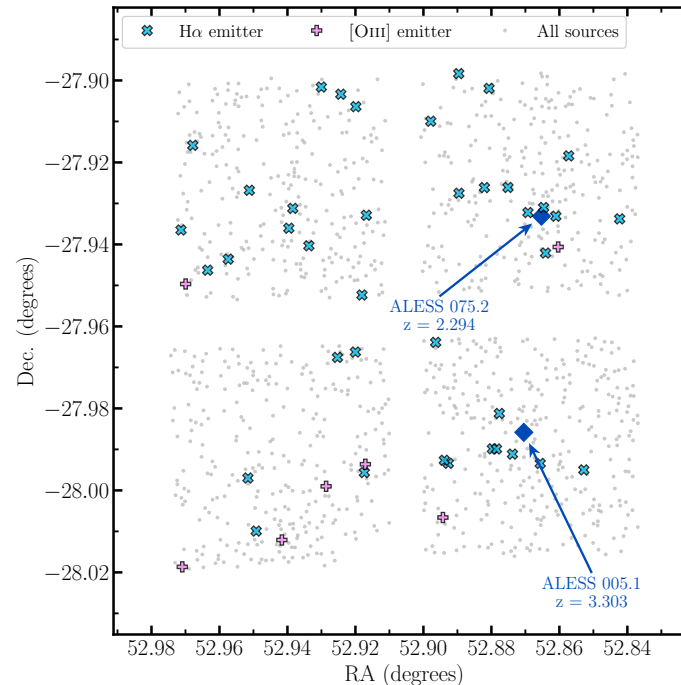


[OIII] (+ H β)



Conclusions

- We have conducted a narrowband study in search of overdensities of star-forming galaxies around three known SMGs at $z \sim 2.3$ and $z \sim 3.3$.
- Our results suggest a substantial overdensity around at least two of the SMGs => potential protoclusters.
- Further analysis required to determine if the other two SMGs reside in significant overdensities.



A vibrant nebula with a mix of blue, orange, and red colors, set against a dark background filled with stars. The text "Thank you" is centered over the nebula.

Thank you