Extreme UV emitting Lyman Continuum leakers at the Cosmic Noon

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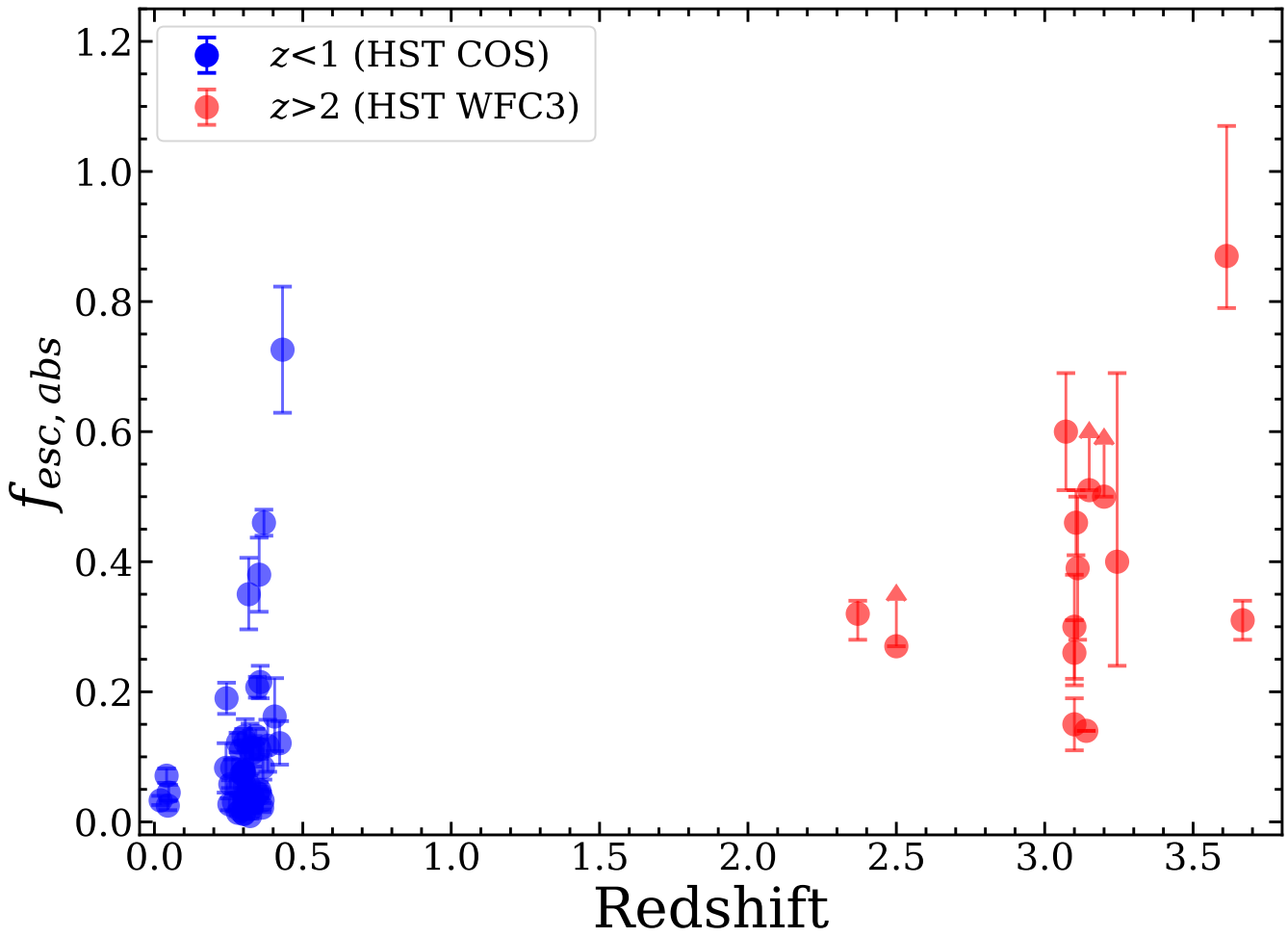
Redshift distribution of LyC leaking galaxies



Leitet et al. (2013); Borthakur et al. (2014); Leitherer et al. (2016); Izotov et al. (2016, 2018, 2021); Flury et al. (2022); Shapley et al. (2016); Vanzella et al. (2010, 2016); Bian et al. (2017); Fletcher et al. (2019); Rivera-Thorsen et al. (2019); Marques-Chaves et al. (2021, 2022).

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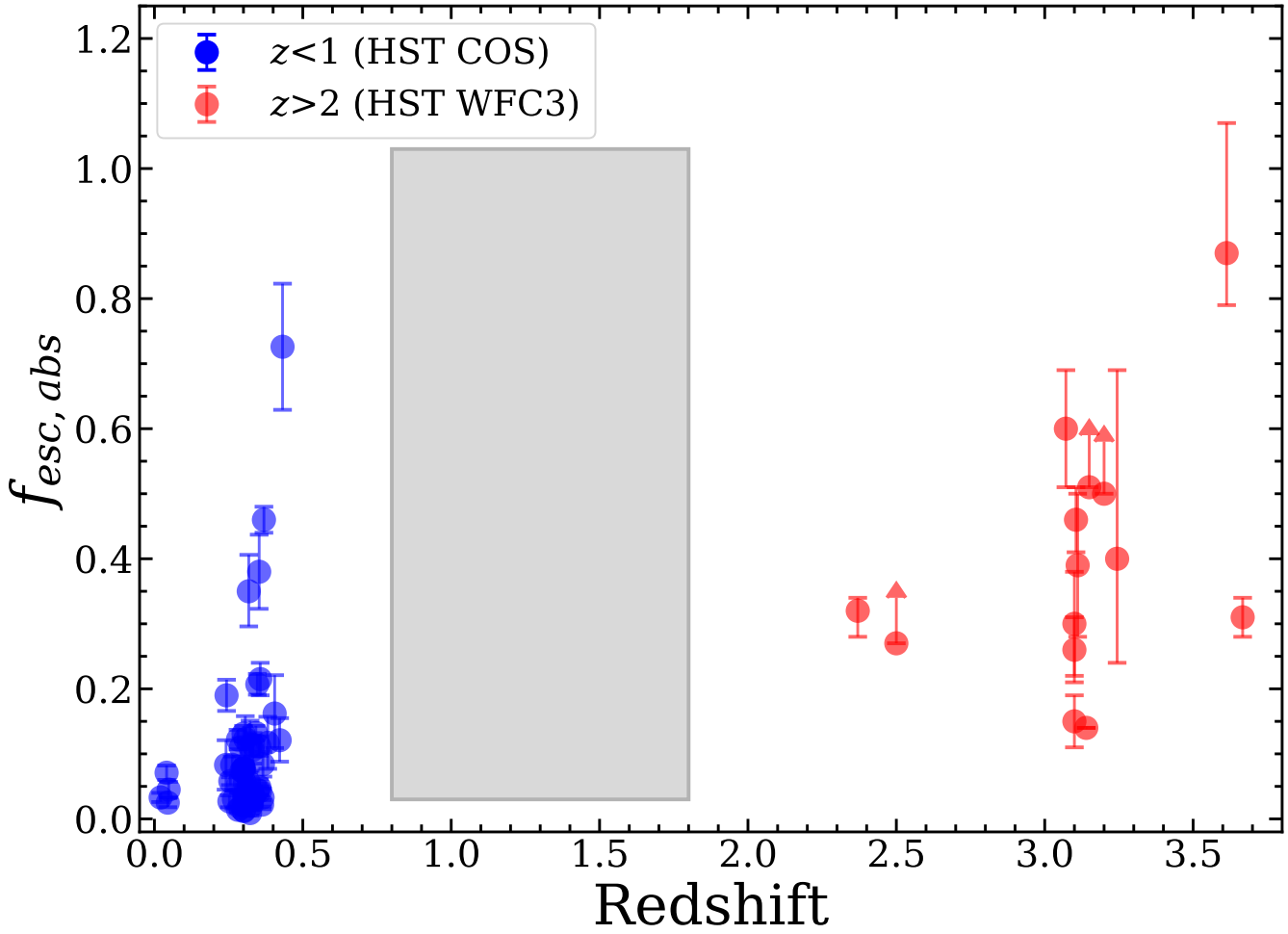

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Detecting LyC photons is challenging!!

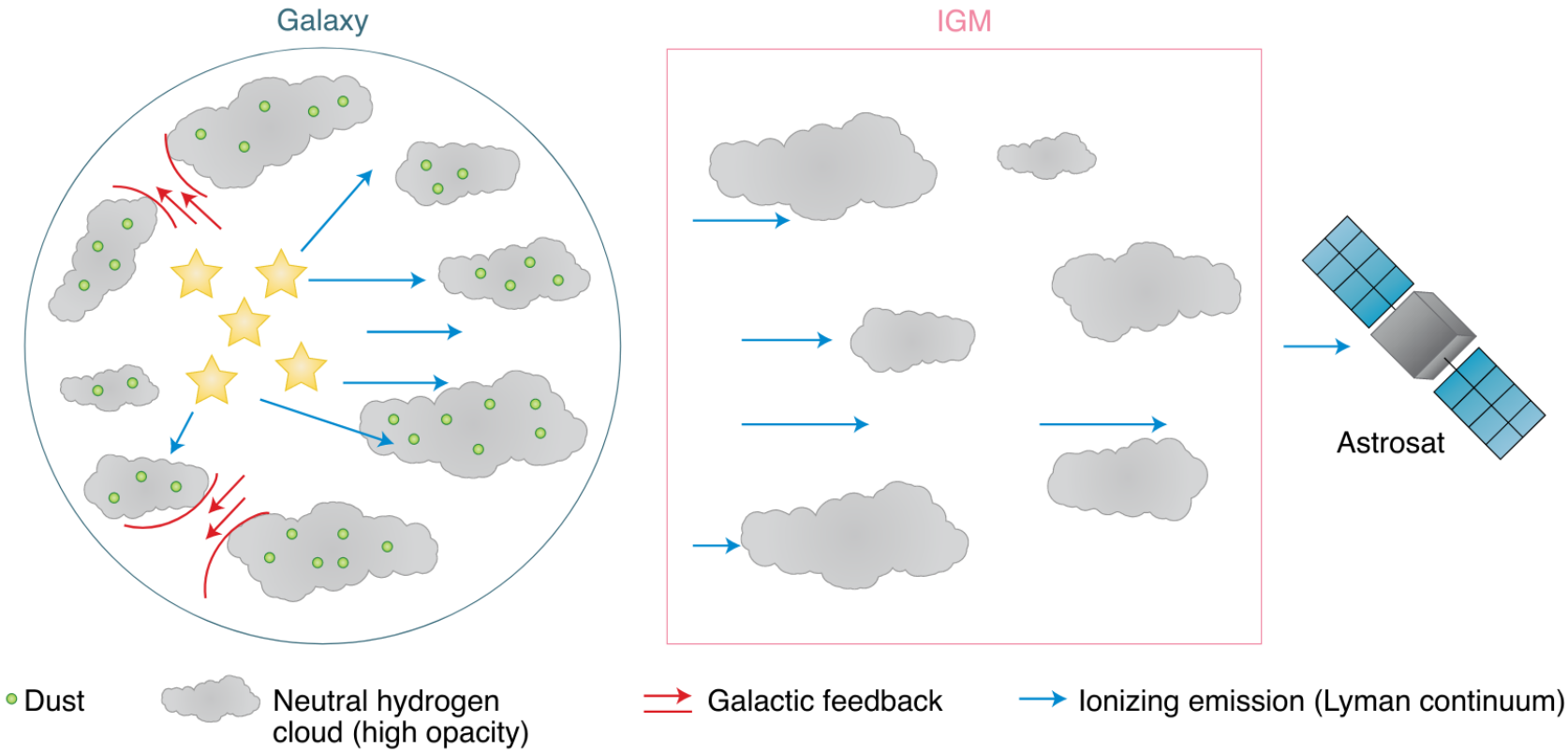
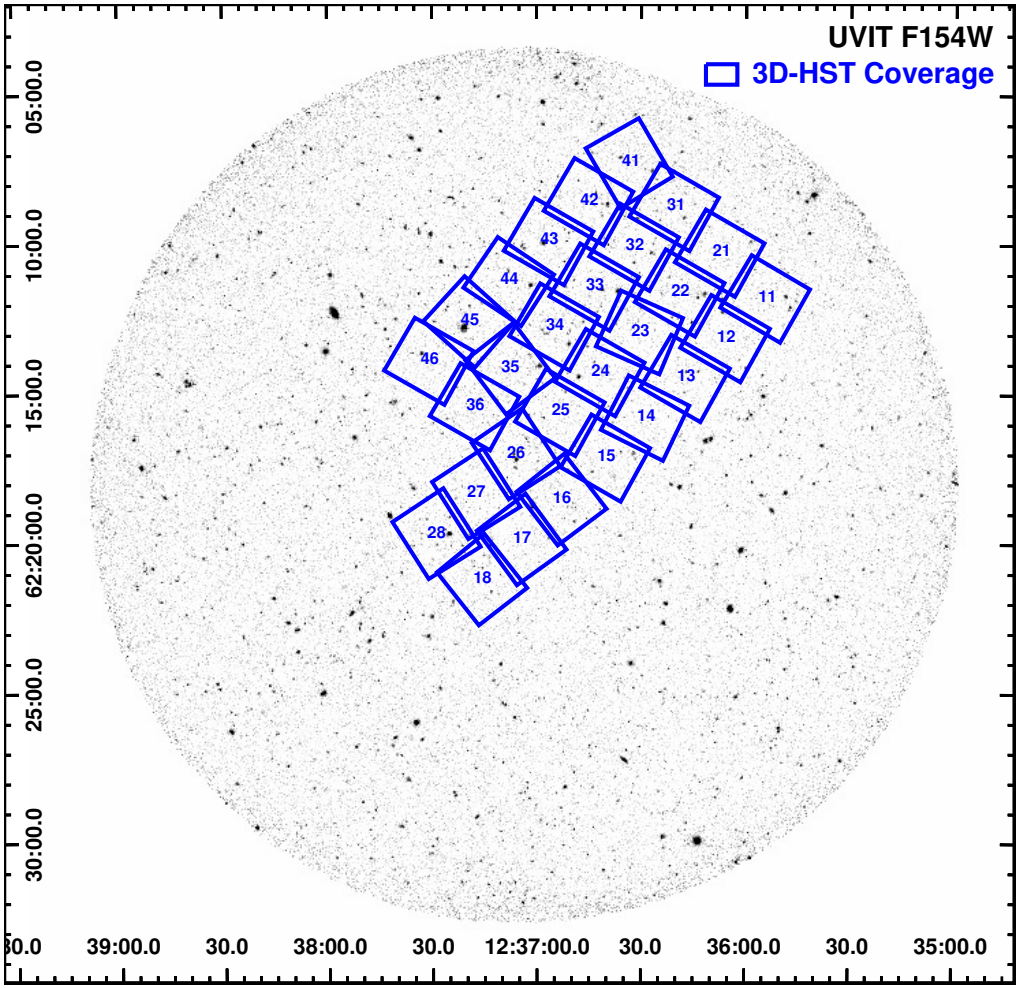


Figure from Alavi (2020)

ASTROSAT UV Deep Field North



AUDF ideal for LyC leaker detections

Lyman Limit $\sim$912 Å

λ_{mean} = 1541 Å

$\Delta\lambda$ = 380 Å

Any source detected in F154W band at z$>$ 0.97 would be a LyC leaker.

PI: Kanak Saha

ASTROSAT UV Deep Field North

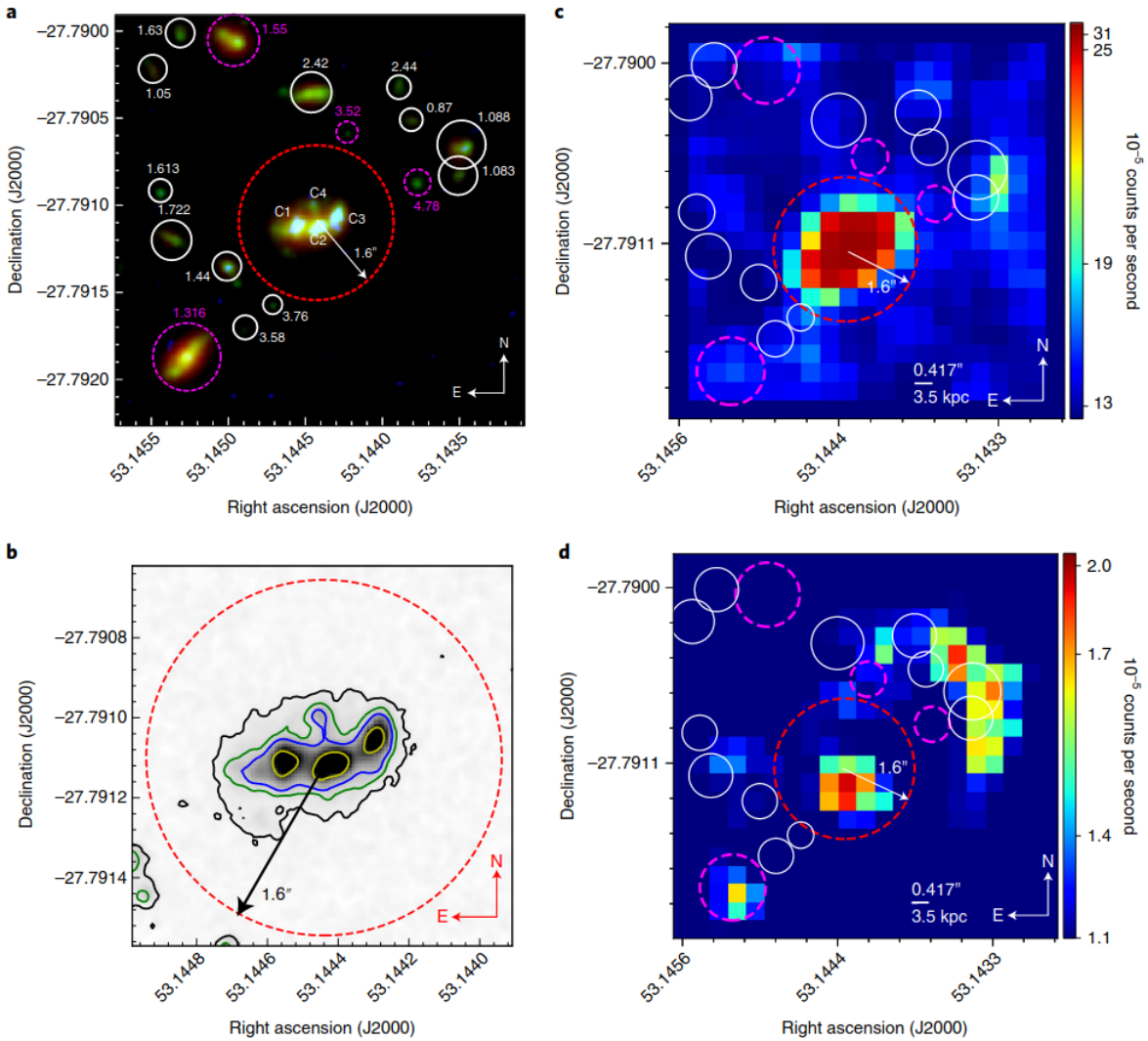
UVIT Imaging

FUV F154W $\sim$ 34 kilo sec
NUV N242W $\sim$ 19 kilo sec
Resolution: FUV $\sim 1.5''$, NUV $\sim 1.2''$
5σ limiting magnitude FUV$\sim$26.79, NUV$\sim$26.73

3D-HST Grism spectra and deep imaging archival data

WFC3/G141 spectra with wavelength coverage from 1.1-1.6 μm.
Spatial resolution $\sim 0.''13$
Deep imaging in UV (HST, UVIT), Optical (HST, Keck, Subaru) and IR (HST, Subaru, Spitzer).

First LyC leaker detection using UVIT



Kanak Saha et. al. (2020)

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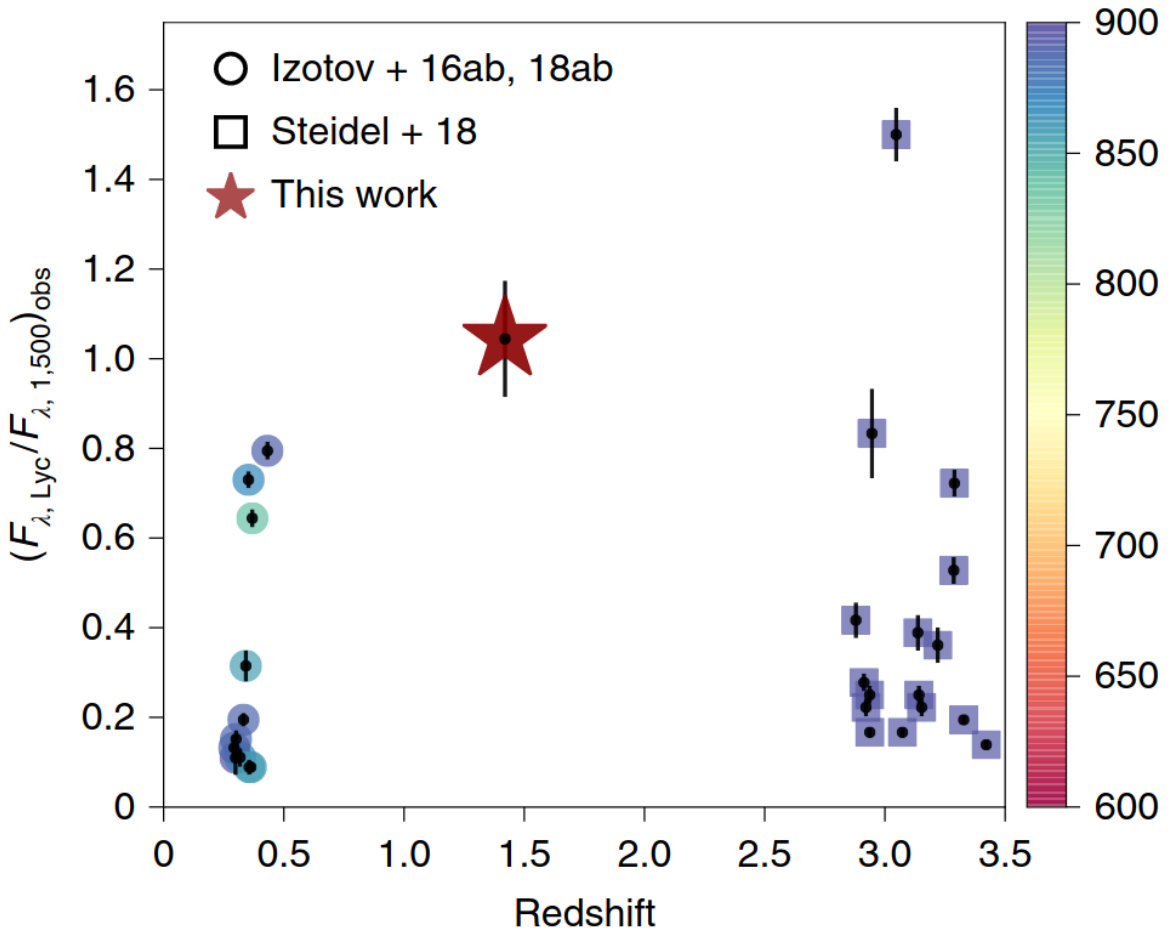
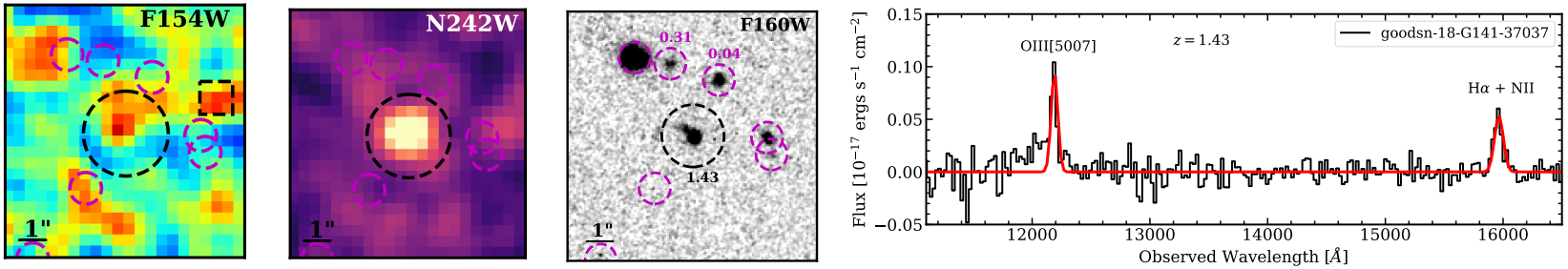


Kanak Saha et. al. (2020)

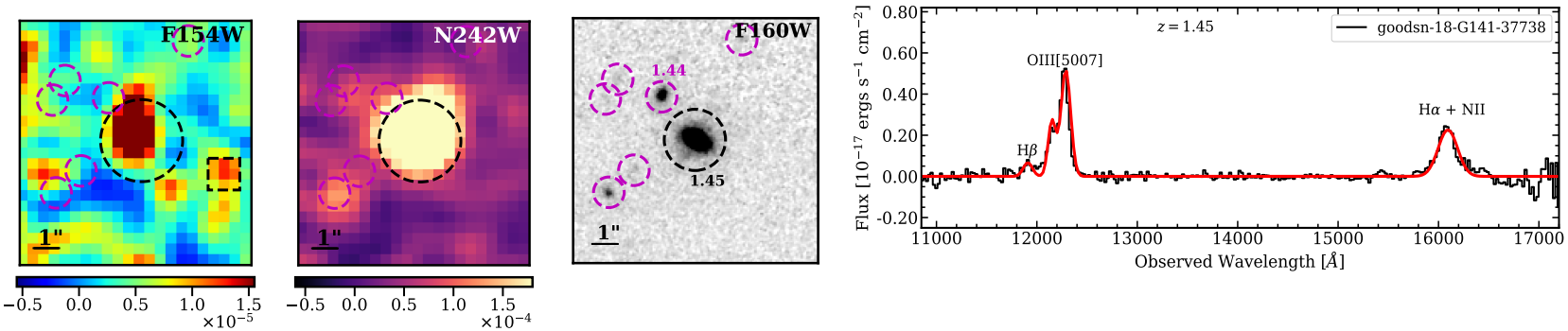
Identifying LyC leakers

- We use the Hα and [OIII]5007 lines having line flux SNR > 3 to identify emission line sources (178 sources).
- Of the 178 sources, 56 sources are found to have detection in UVIT F154W.
- To avoid contamination, sources having neighbouring companions within 1.2″ radius are excluded (39 sources).
- 11 sources are found with FUV SNR $>$ 3.
- One source in this 11 sources is observed to have Hα line at the edge of the spectral coverage of G141. To avoid uncertainty in redshift and line flux measurement we exclude this source from our sample.

LyC leakers Images and Spectra

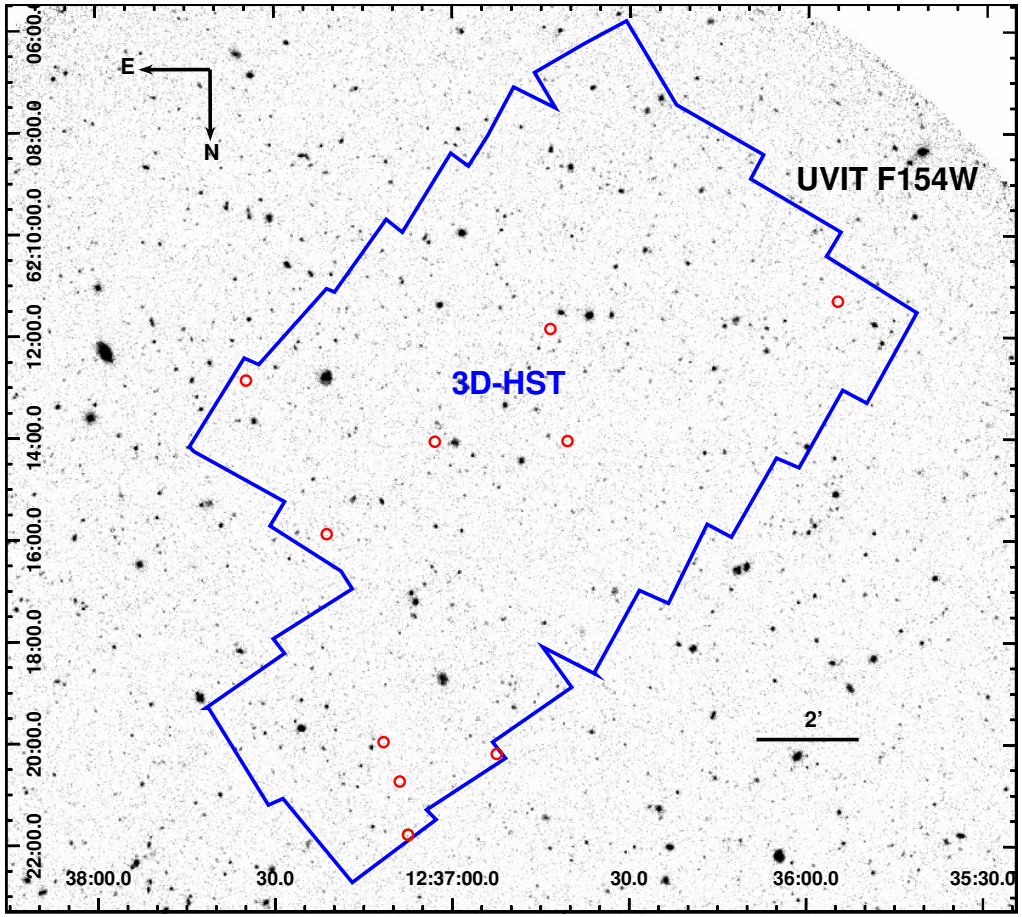


FUV mag: 26.10±0.33, f_{esc}: 0.60±0.04, Rest Frame UV λ: ∼630 Å



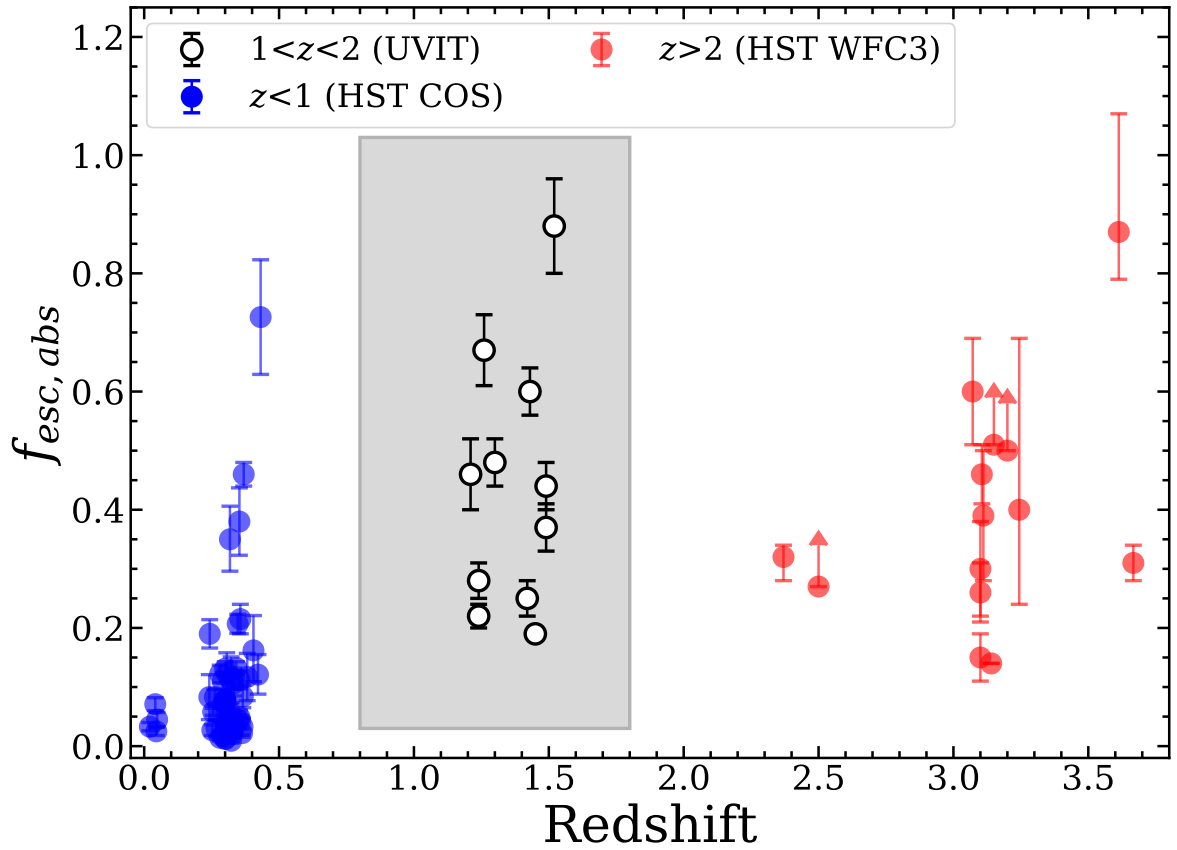
FUV mag: 25.55±0.24, f_{esc}: 0.19±0.01, Rest Frame UV λ: ∼630 Å
Dhiwar et. al. 2024, ApJL

LyC leakers in AUDFn



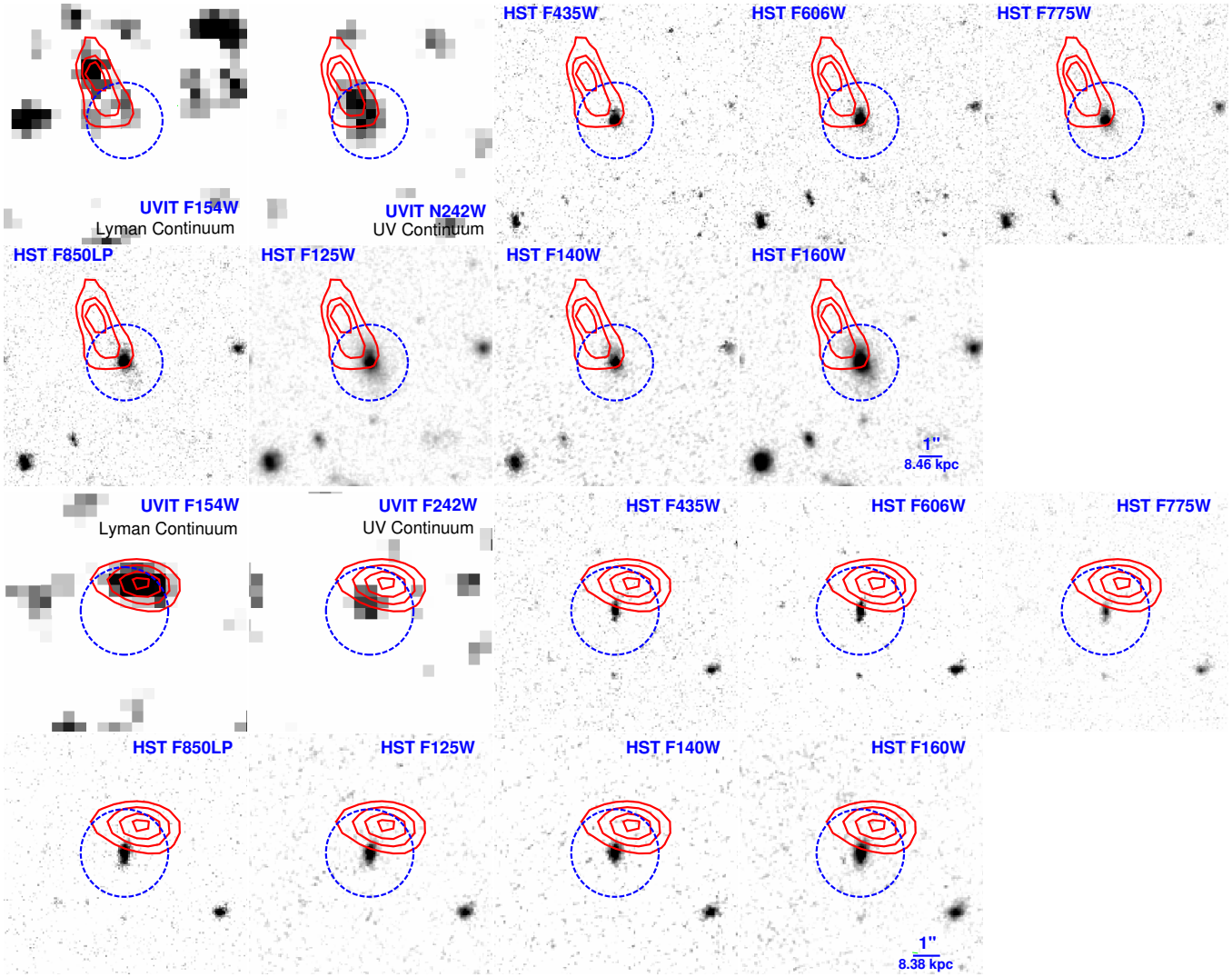
Dhiwar et. al. 2024, ApJL

LyC leaker in AUDFn



Dhiwar et. al. 2024, ApJL

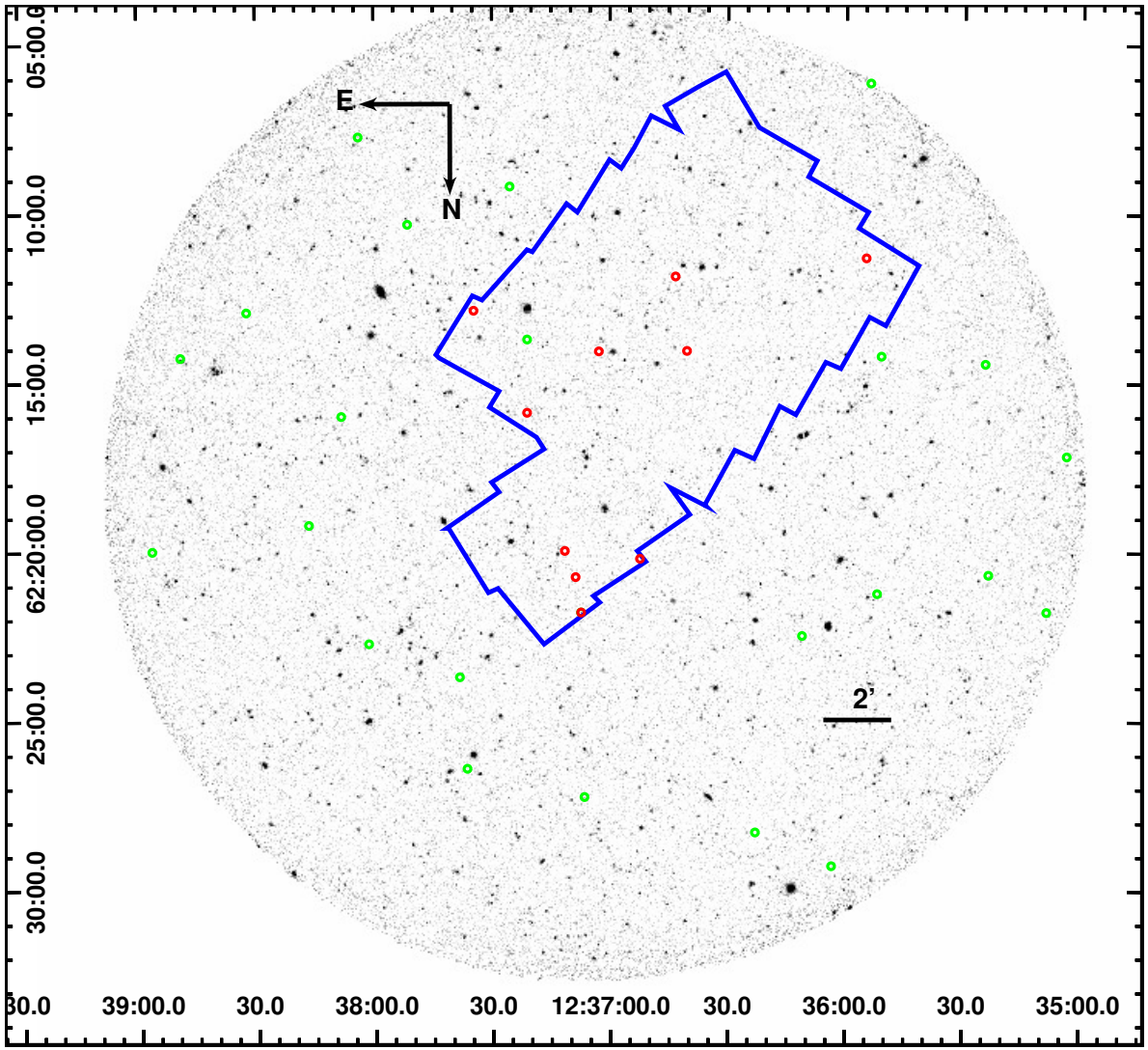
Offset in LyC emission



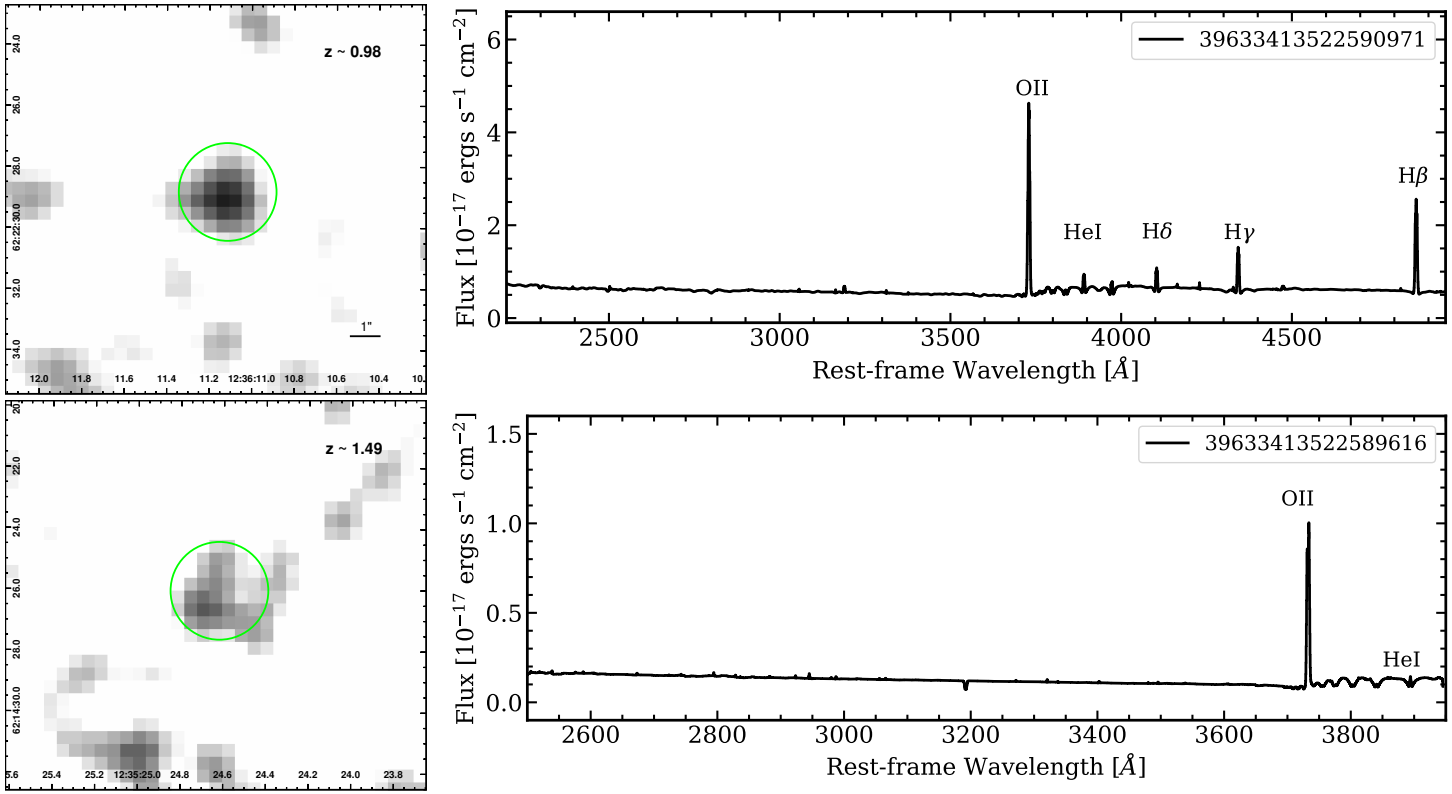
Properties of LyC leakers

ID	z	f_{esc}	β	SFR (Hα) $M_\odot\ yr^{-1}$	Stellar mass $\times 10^9 M_\odot$
goodsn-33-G141_11332	1.24	0.15±0.04	-0.60	31.46±1.73	9.06±2.59
goodsn-17-G141_36246	1.26	0.56±0.10	-1.04	4.49±1.14	3.12±0.77
goodsn-36-G141_25099	1.52	0.79±0.13	-0.21	2.41±1.70	4.49±0.48
goodsn-18-G141_37037	1.43	0.44±0.08	-1.06	10.94±1.47	4.35±1.02
goodsn-35-G141_18763	1.24	0.19±0.05	-0.48	22.74±2.14	7.78±1.20
goodsn-11-G141_09345	1.21	0.35±0.09	-0.48	8.09±1.79	7.33±1.44
goodsn-18-G141_37738	1.45	0.11±0.02	-0.96	124.45±2.78	58.61±6.55
goodsn-17-G141_35906	1.30	0.36±0.08	-0.27	12.41±1.66	3.87±1.05
goodsn-46-G141_14637	1.49	0.24±0.06	-0.33	30.34±2.74	18.49±4.31
goodsn-24-G141_18817	1.49	0.29±0.06	-0.77	25.85±2.16	4.25±1.31

DESI spectra in AUDFn



DESI spectra in AUDFn

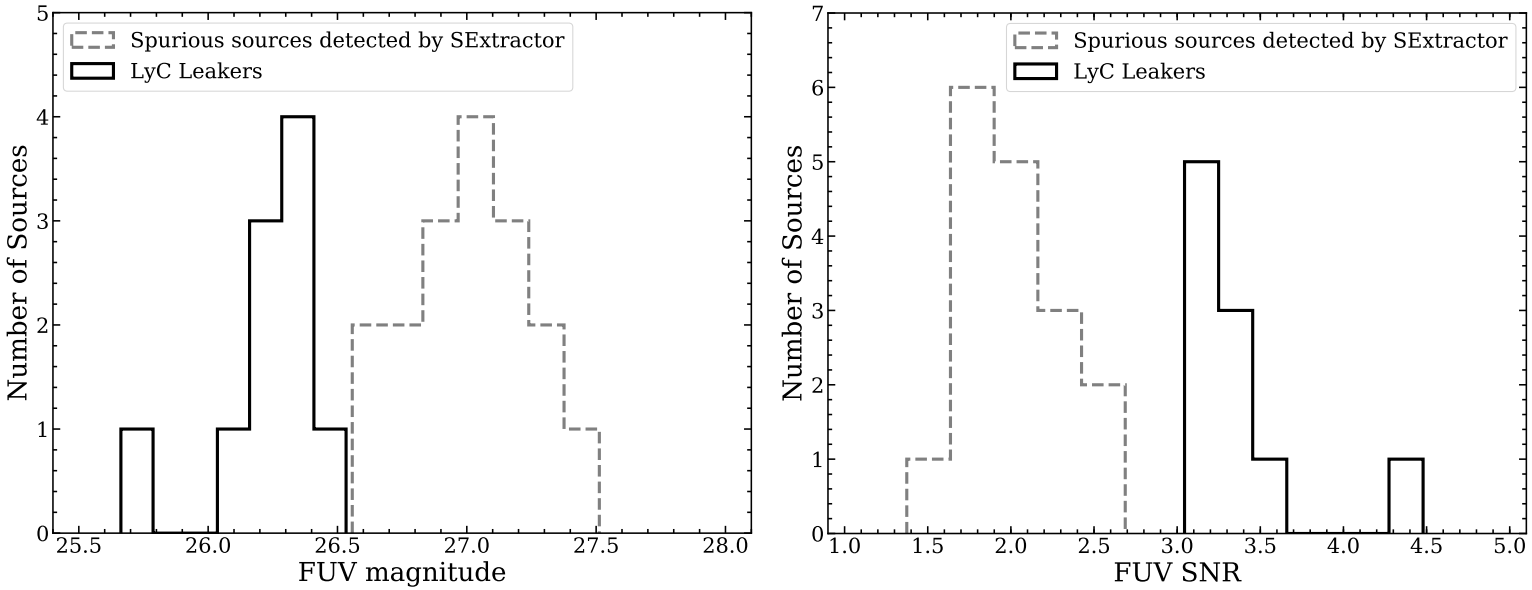


Summary

- Using the UVIT F154W imaging and 3D-HST grism spectra, 10 LyC leakers are detected in AUDFn at $1.0 < z < 1.6$
- This is the first sample of LyC leakers at $1.0 < z < 1.6$
- Escape fractions are estimated to be 10-70%
- The rest frame wavelength of the detected LyC leakers falls in the extreme ultra violet regime $\sim$ 600-750 Å.
- This sample fills an important niche between GALEX and COS at low-z and HST at high-z and and would help in understanding the evolution of LyC leakers.
- We are exploring the fields around 3D-HST using DESI spectra (with $\sim$ 20 potential LyC leakers candidates detected).

Thank you for your attention!

Detection Significance



Estimation of f_{esc}

$$N_{LyC}^{non-esc} = 7.28 \times 10^{11} L(H\alpha), (non-escaping\ ionizing\ photons) \quad (1)$$

$$N_{LyC}^{esc} = \frac{L_{F154W}(\lambda_{mean}^{F154W})^2}{hc} e^{\tau_{IGM}}, (escaping\ ionizing\ photons) \quad (2)$$

$$f_{esc} = \frac{N_{LyC}^{esc}}{N_{LyC}^{esc} + N_{LyC}^{non-esc}} \quad (3)$$