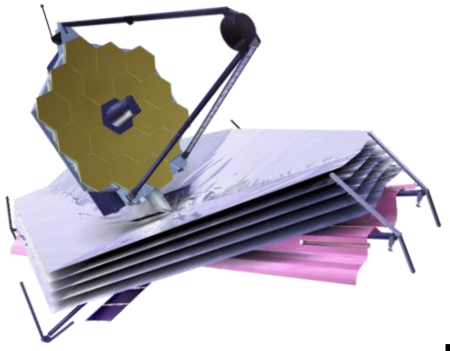
Deciphering Cosmic Reionization History Encrypted In the Galaxy UV Continua

Hiroya Umeda (Utokyo)

Based on

1. Umeda et al. (2024), ApJ, 971, 124
2. Umeda et al. (2025a), ApJS, 277, 37
3. Umeda et al. (2025b), on arXiv

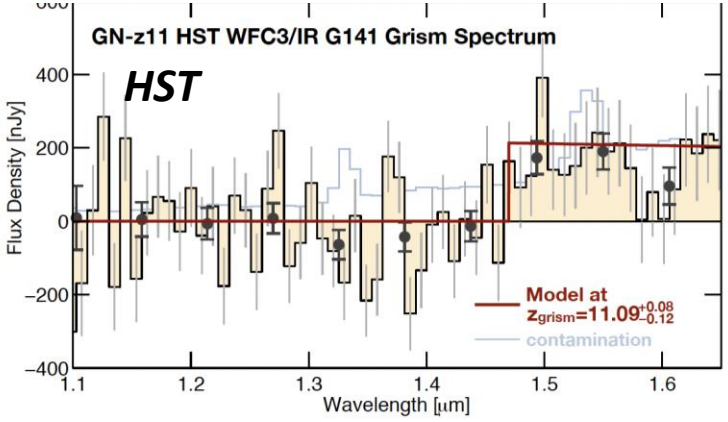
Escaping the Lyman Labyrinth



The Era of JWST

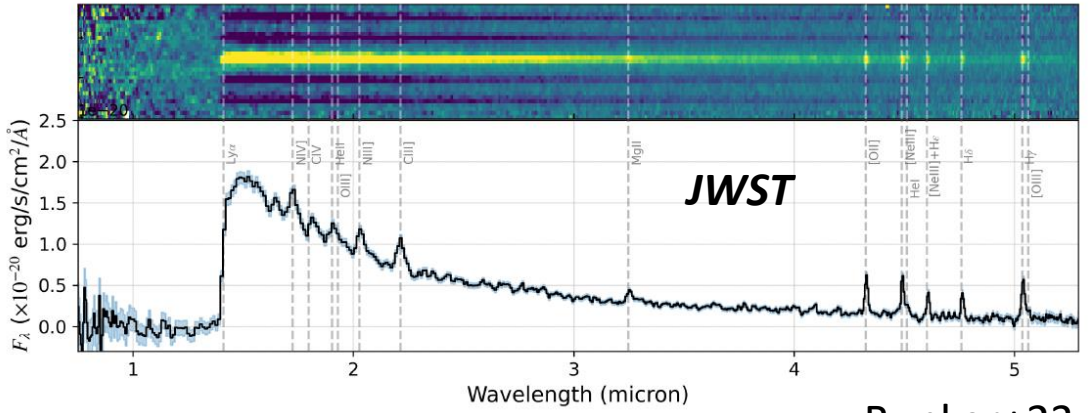
Remarkable Achievements

UV Continuum Detection at z=4-14

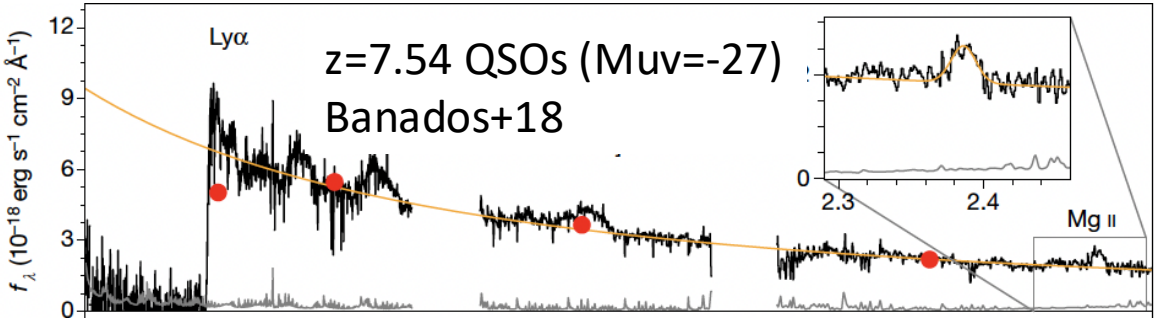


Oesch+16

GNz11 (z=10.6; Muv=-21.5)



Bunker+23

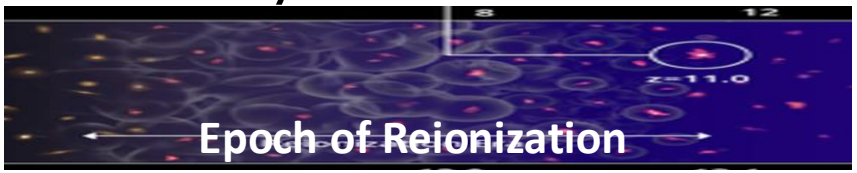


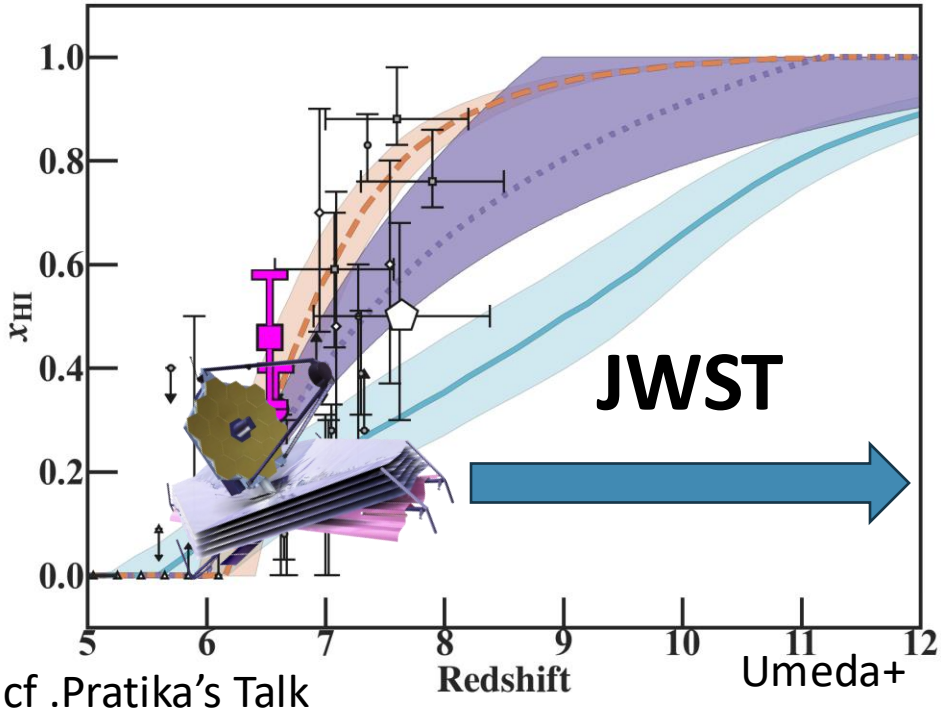
As Clear Continuum Signal
As If its QSOs!

JWST Dives Into the Neutral Universe

Nature of IGM via Galaxy Observation

Lyα Emission and ... Continuum Absorption?





cf .Pratika's Talk

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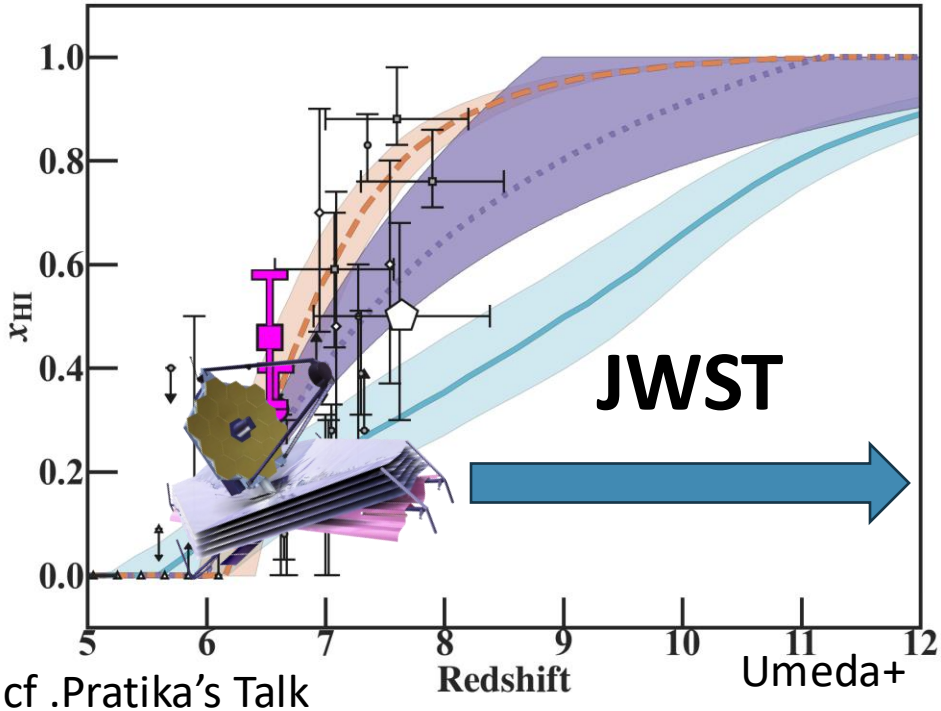

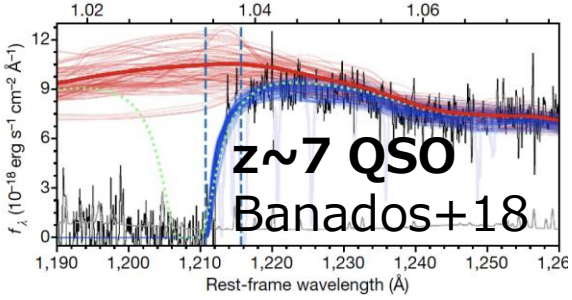

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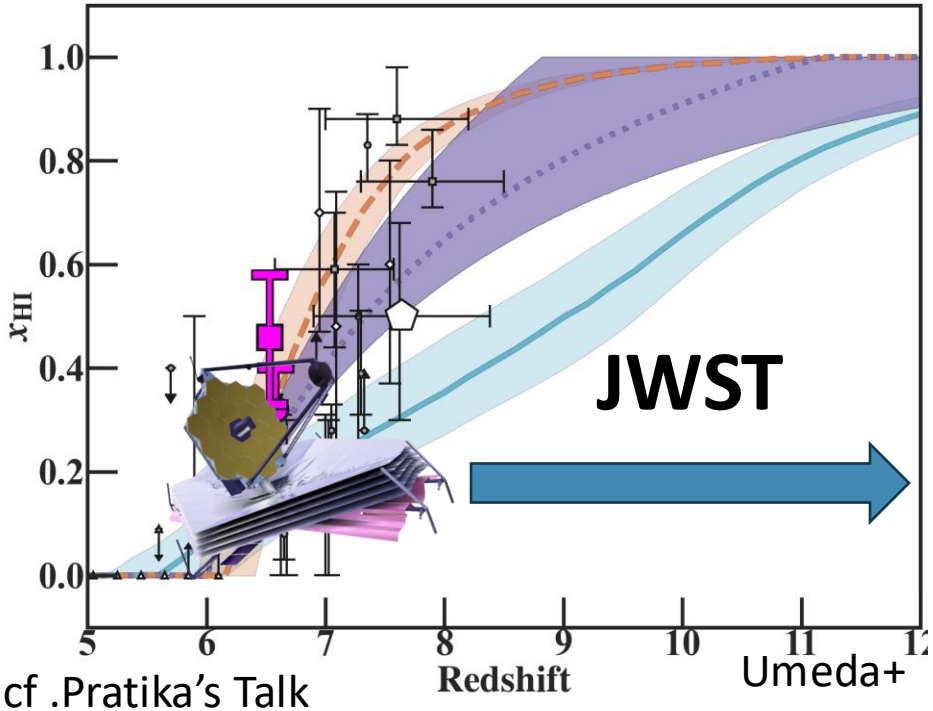

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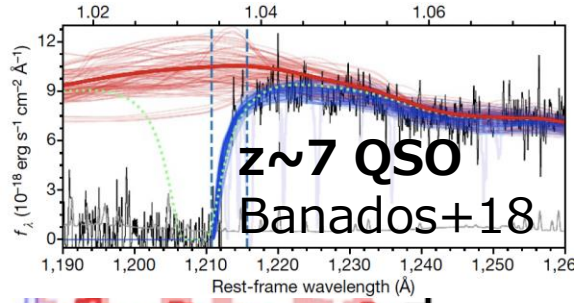
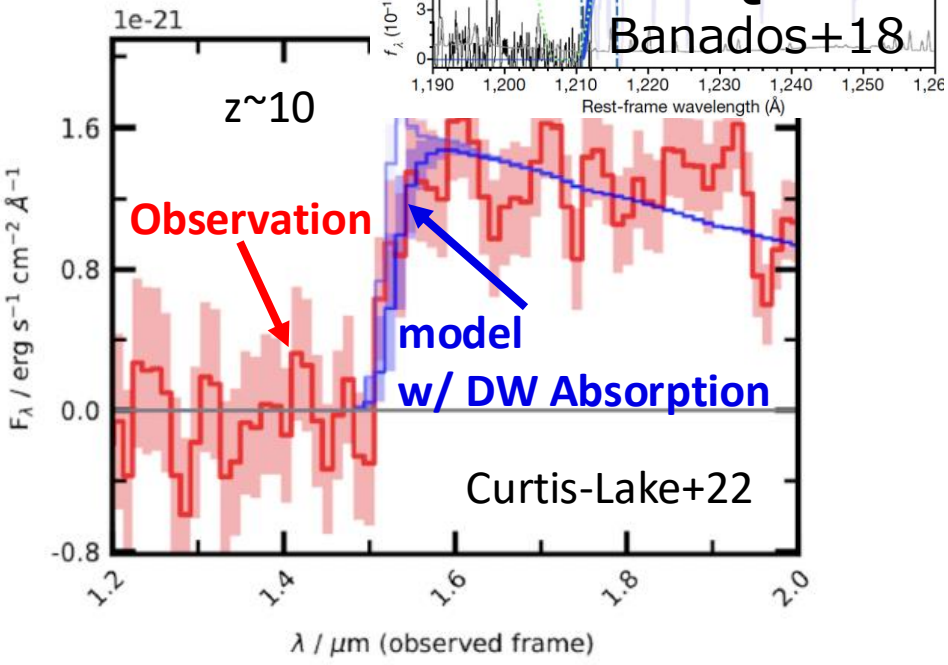
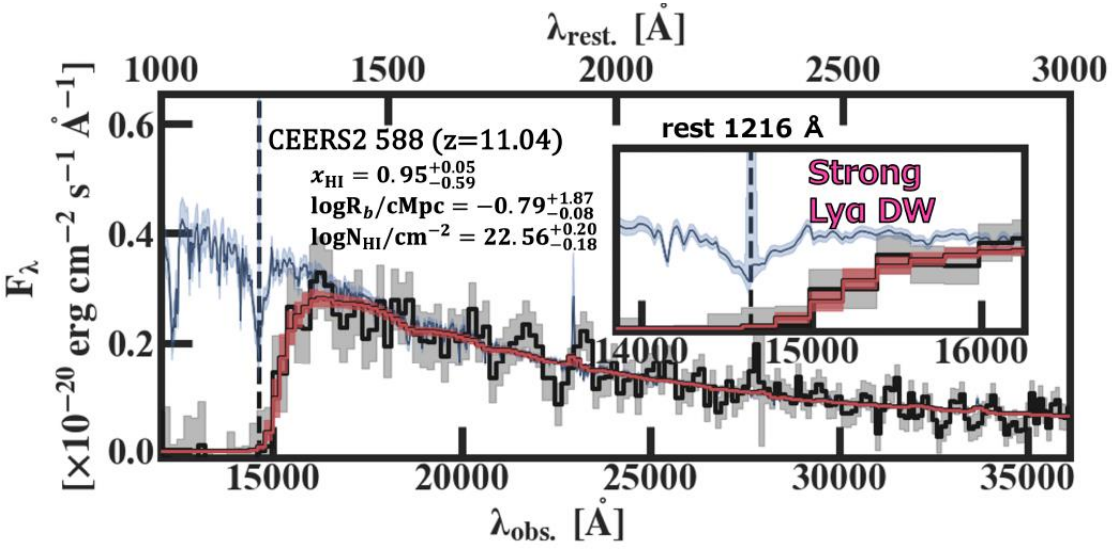
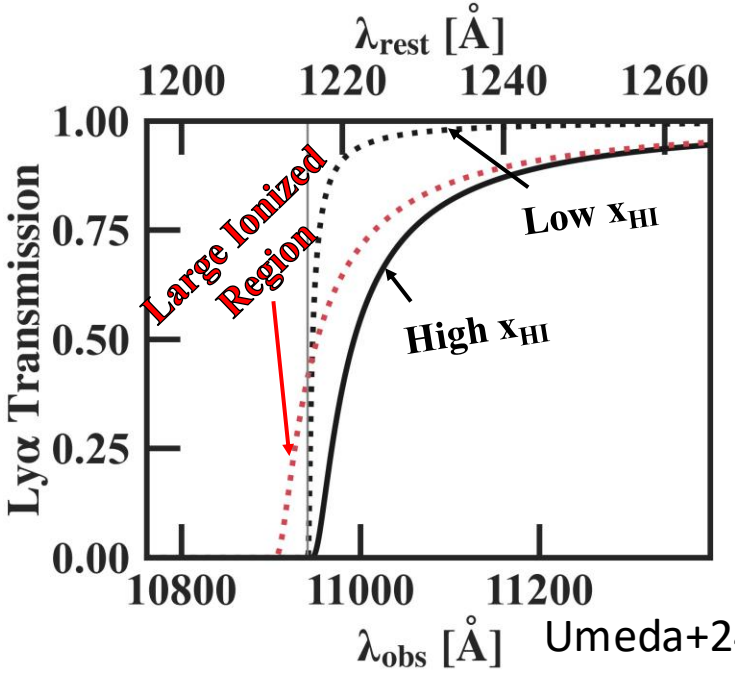




Galaxy UV Continua Absorption As A New Tool



Umeda+24



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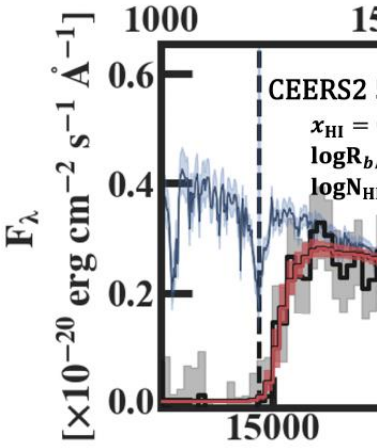
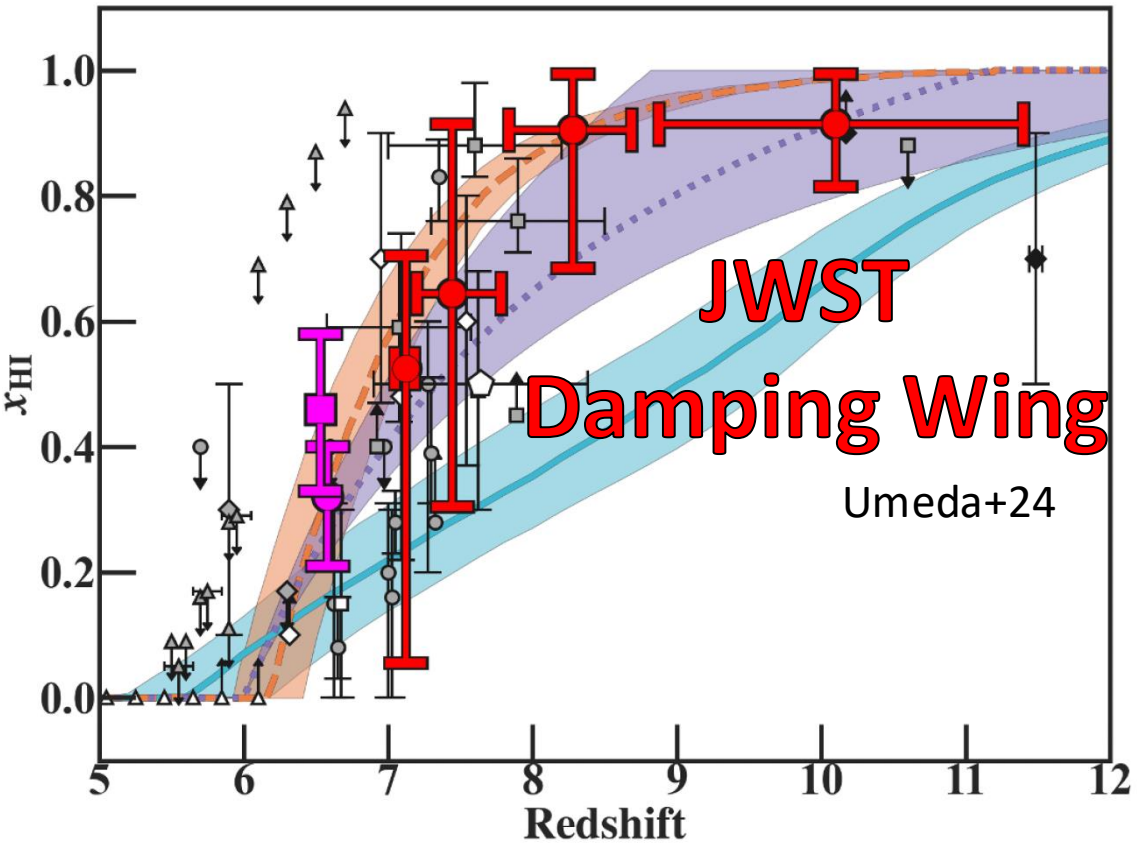
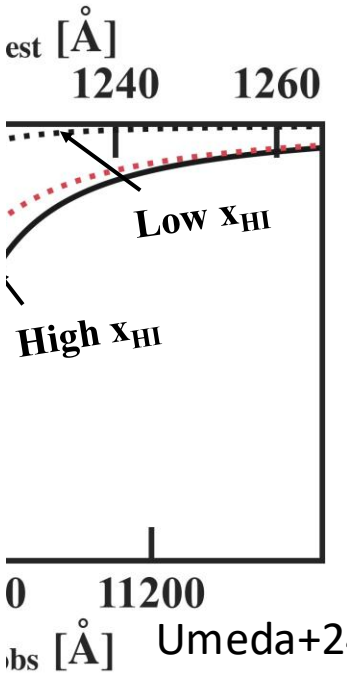
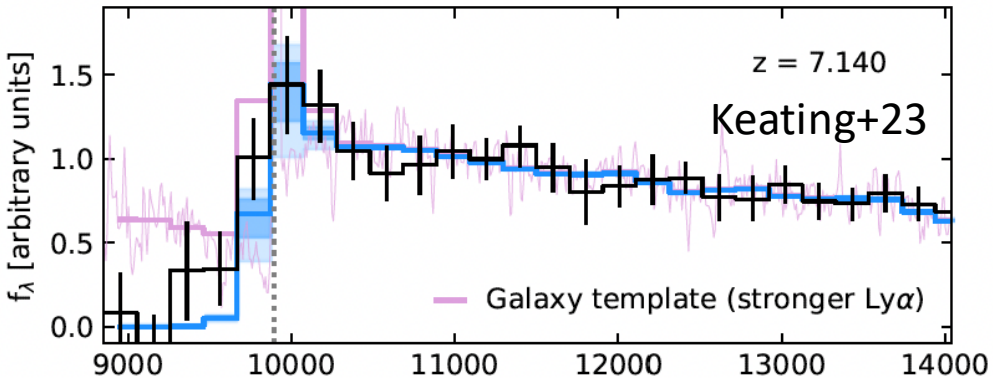




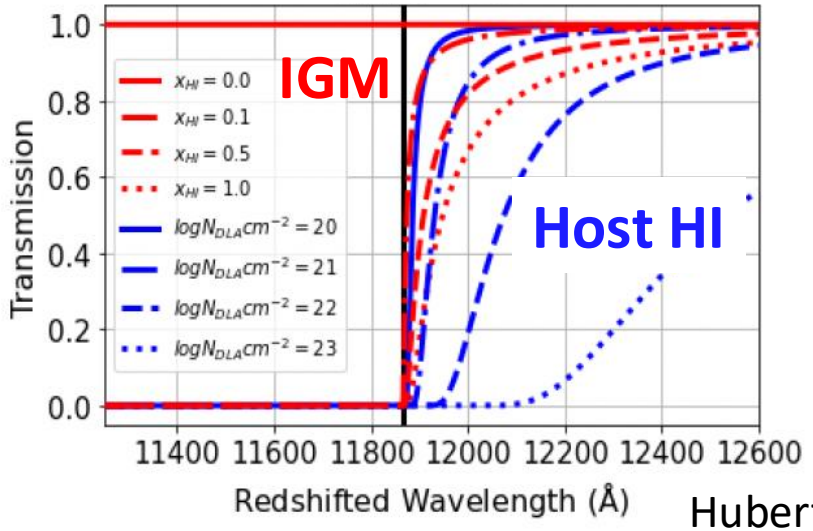


Advances in UV-Continuum Absorption Analysis

Lyα Emission



Host Galaxy Absorption



Huberty+25 (cf. Heintz+24, etc…)

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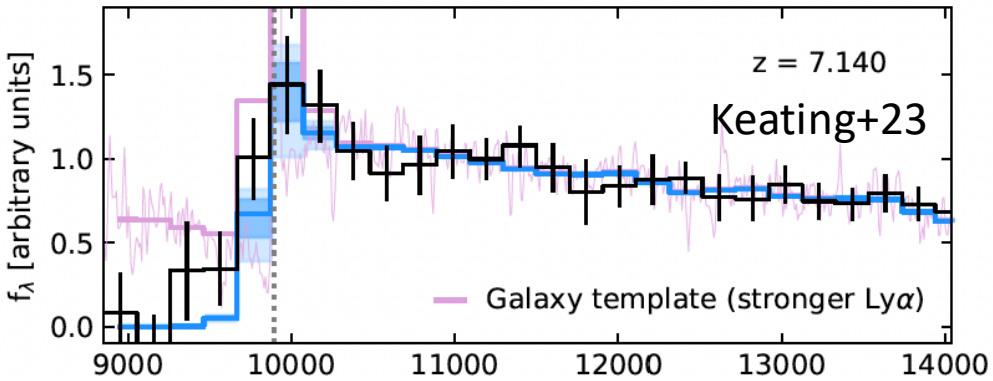

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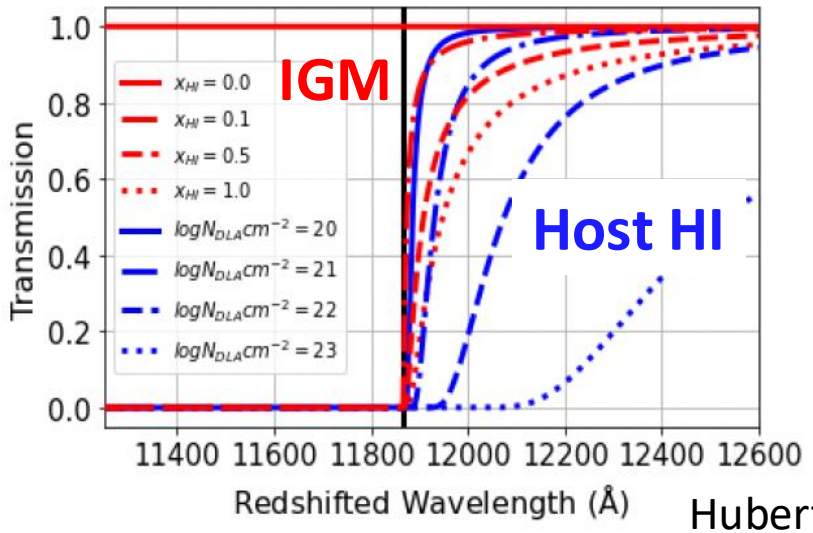
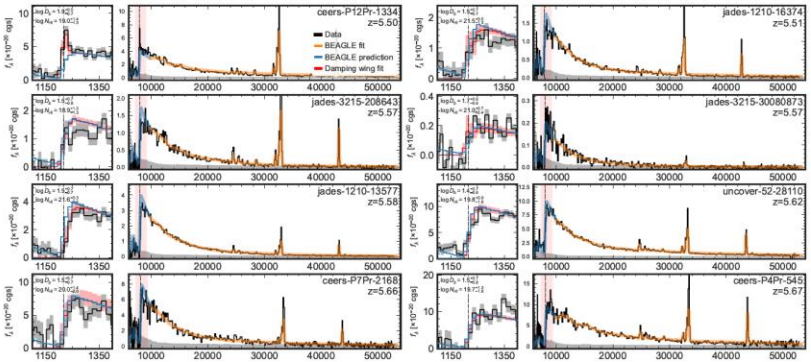
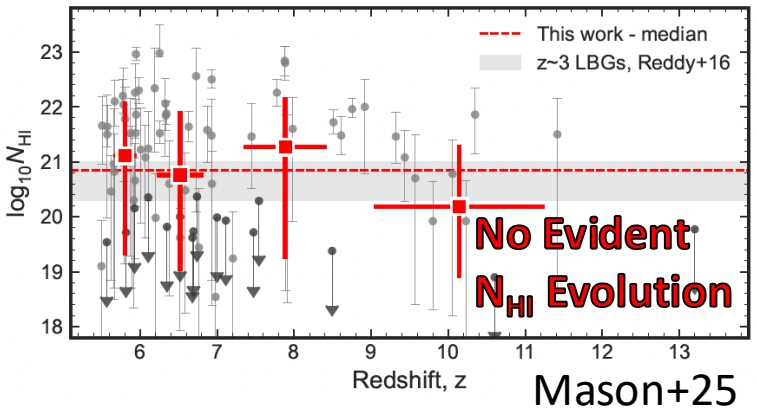


Updated Modeling

Bayesian Inference Framework and Semi-Numerical Simulation





Huberty+25 (cf. Heintz+24, etc…)

Mason+25
(cf. Umeda+24)

Our Strategy: Template-base Analysis

JWST Galaxy Spectra

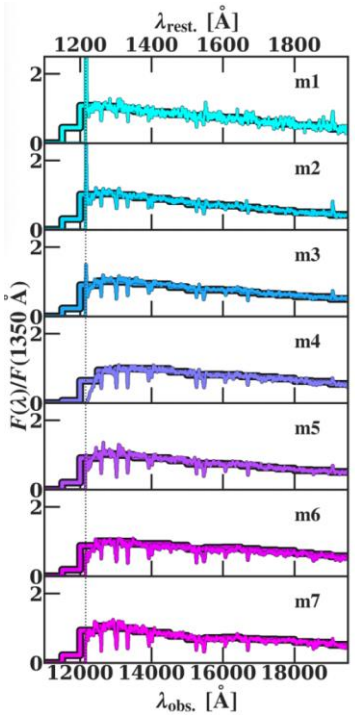
>100 Galaxies at z>5

⇩

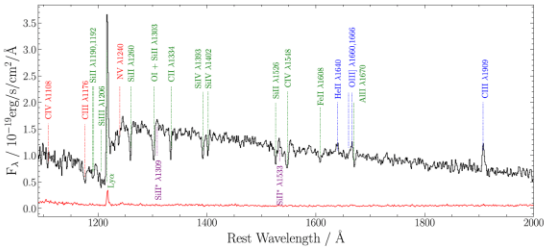
Composite Spectra with Homogeneous Subsample (e.g., Redshift, UV Magnitude & Slopes)

Modeling

Realistic Template w/ Host HI Absorption



Composite Spectra from >600 Galaxies at z=2-5 (VANDELS; Cullen+19)



Data & Sample

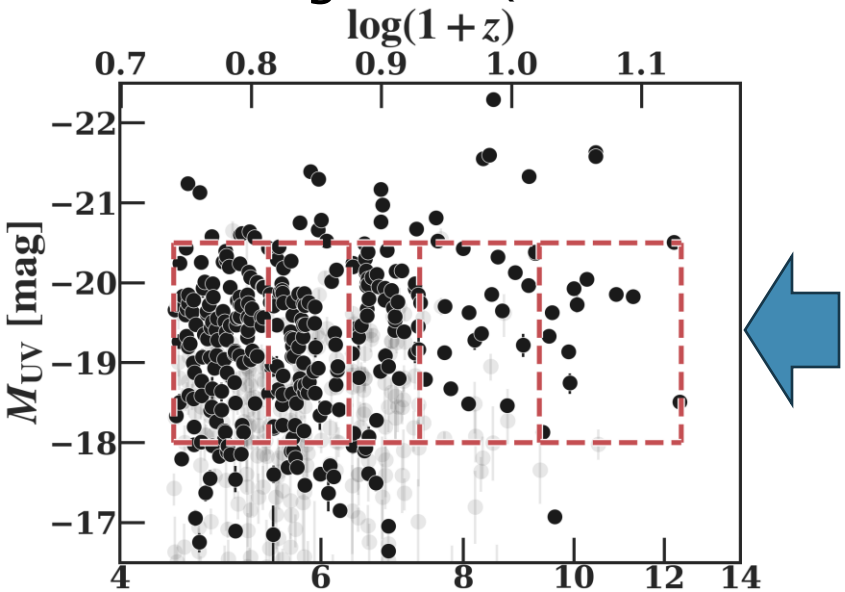
PRISM & Spec-z by Emission→581 Objects in 4.5<z<13 Umeda+25b

Thx to JADES, UNCOVER, CEERS, DD, GO Teams

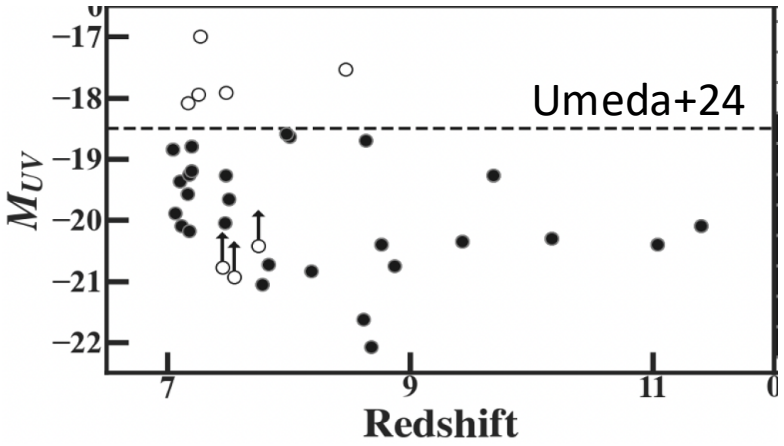
UV Magnitude/Slope Measurement (Method Similar to Saxena+24)

Fiducial Subsamples: -20.5<Muv<-18, -1.8<β<-2.6

Omit Strong LAEs (Measured in same way as Kageura+25)



Umeda+25b



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cf. Nimisha's Talk

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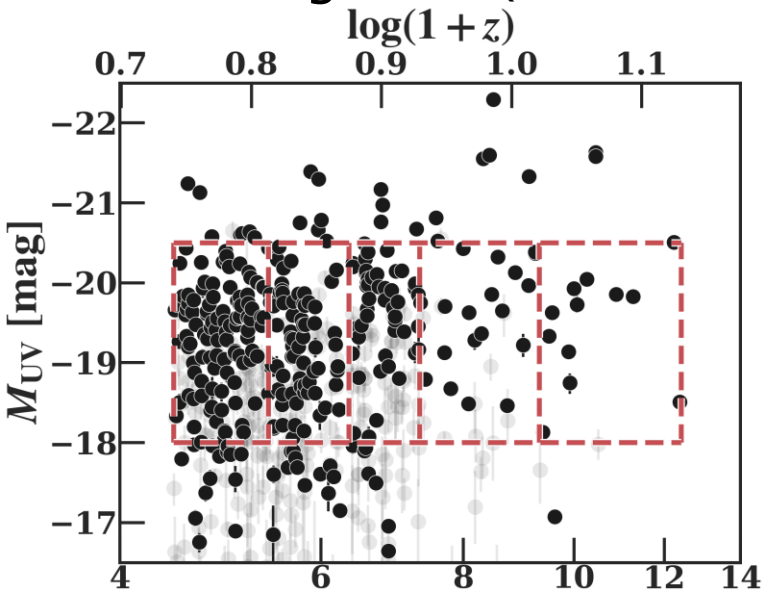

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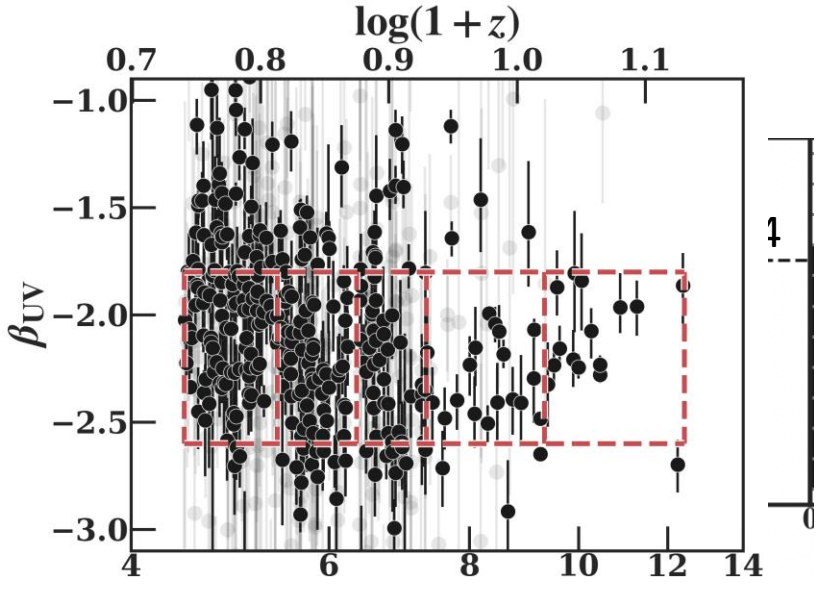

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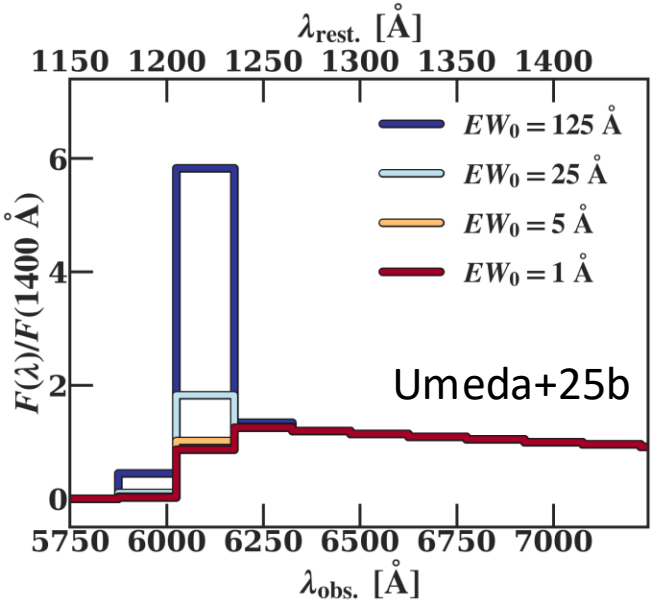

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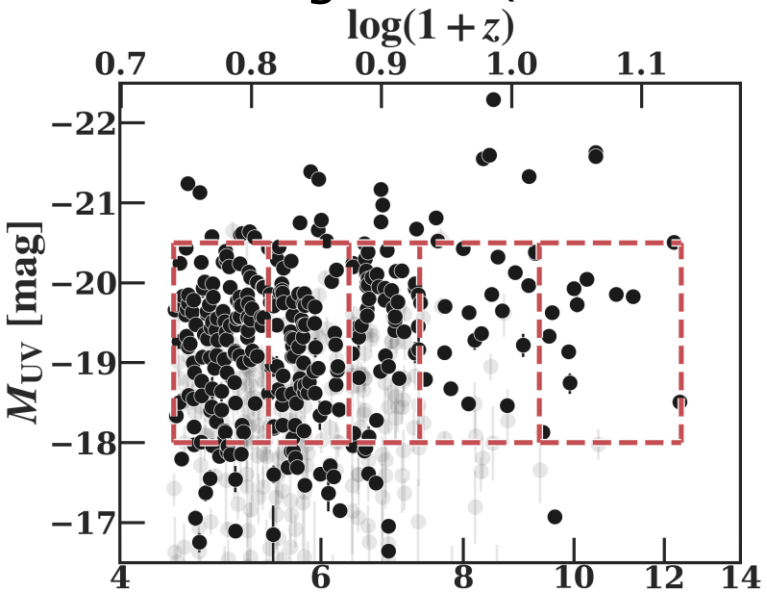

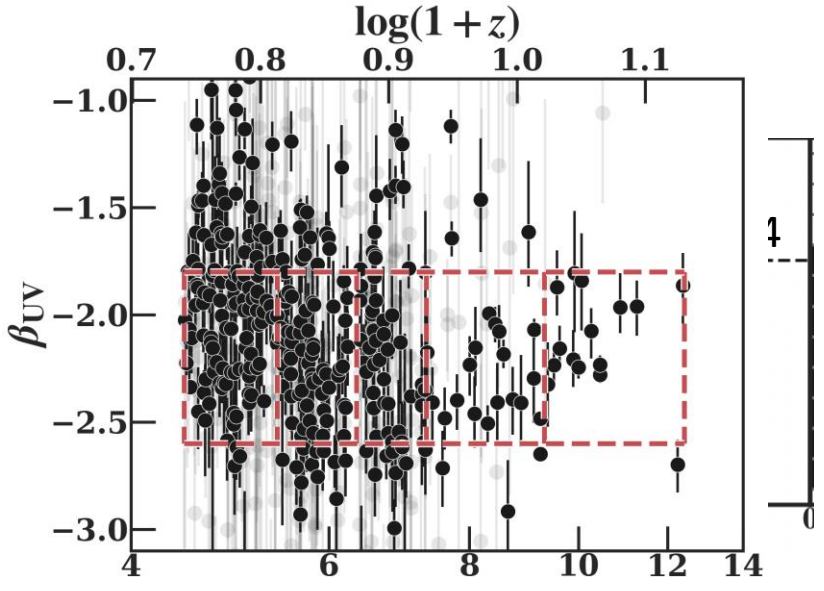

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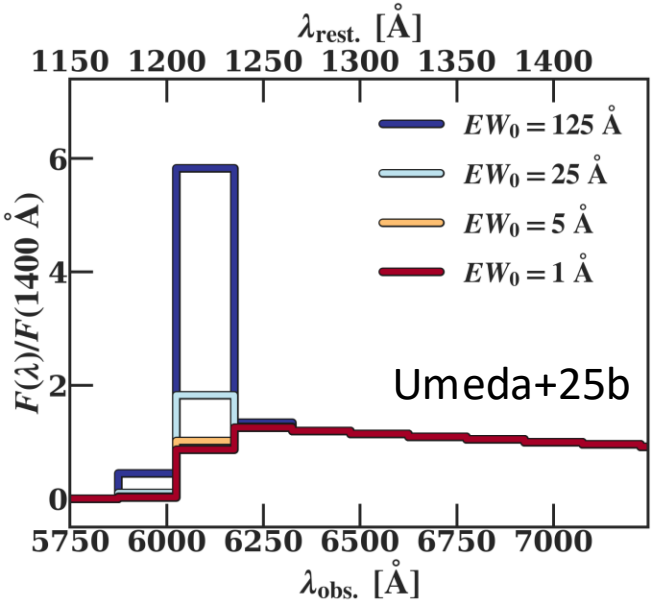

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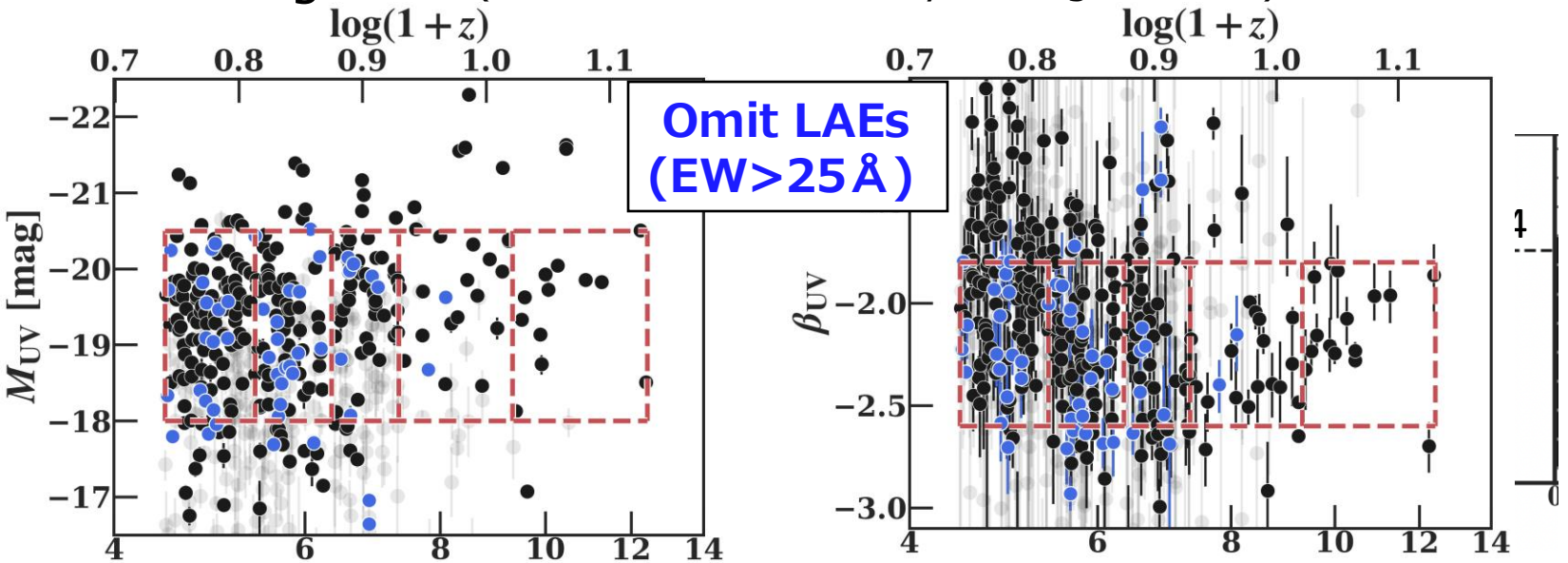


cf. Nimisha's Talk

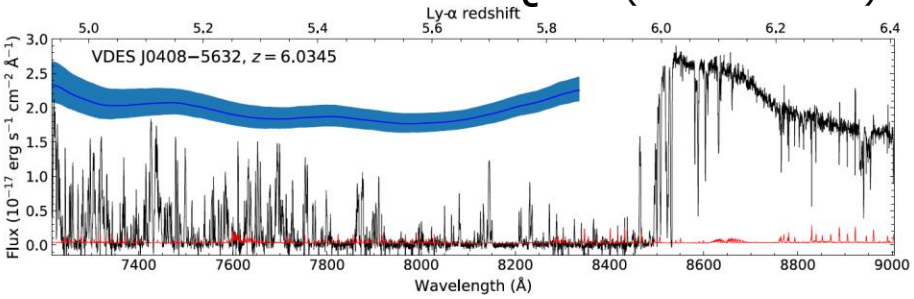
"Tail" of Reionization
Lyα Forest Signals

Bright Looking As Quasar→Lyα Forest!

Lyα Forest Signals with stack data ($\Delta z=0.5$, $4.5<z<6.0$)

Dissipating Signals→Witnessing the End of EoR

QSO (Bosman+22)



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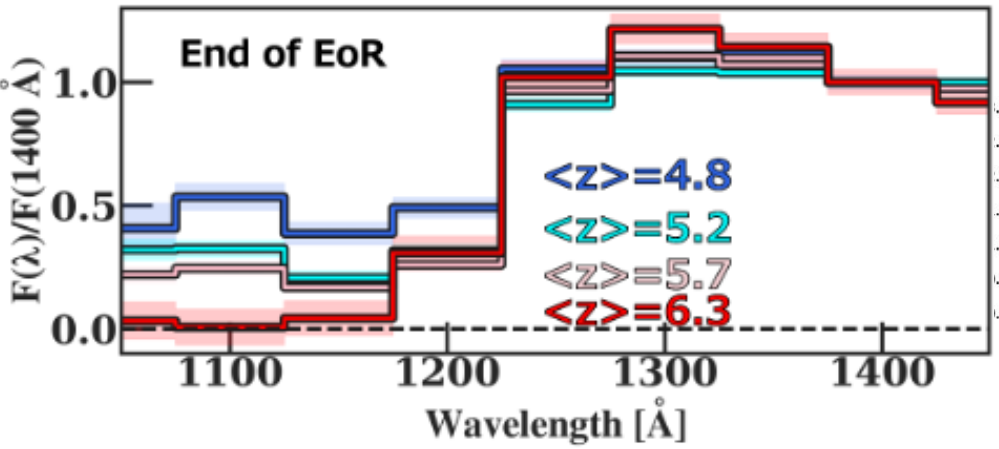

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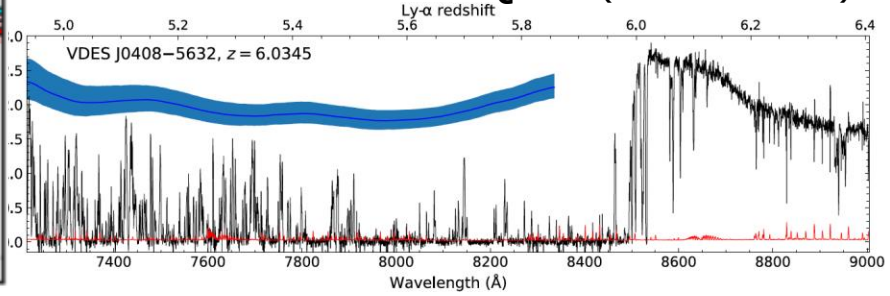

Umeda+25b

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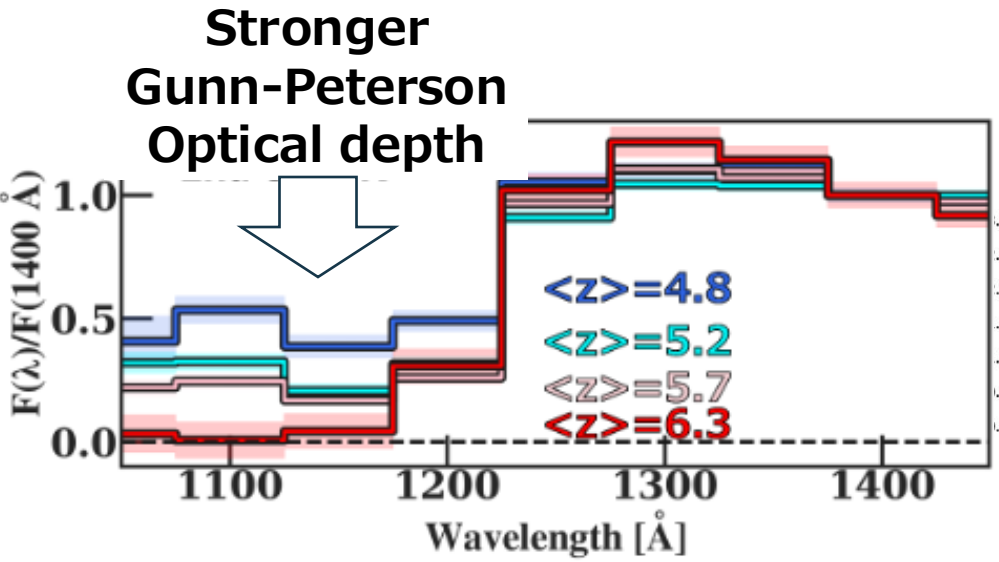

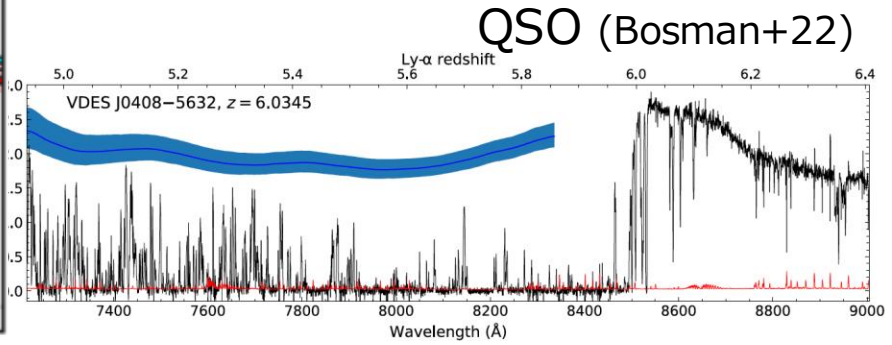

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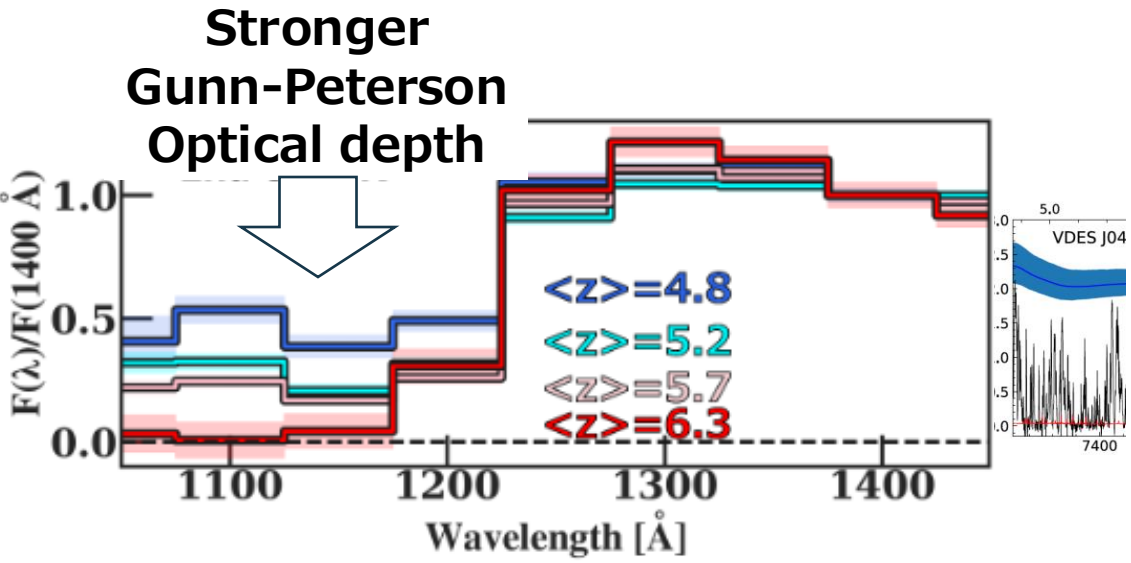

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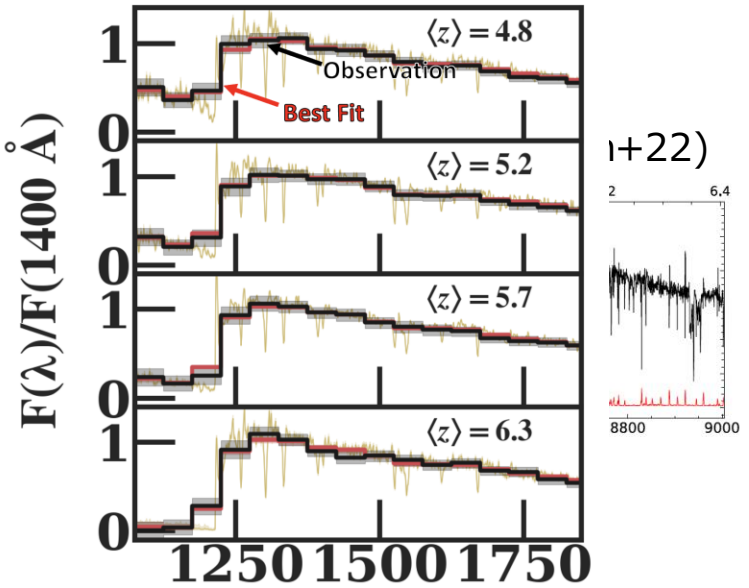

Umeda+25b

(cf. Meyer+25, Mason+25)

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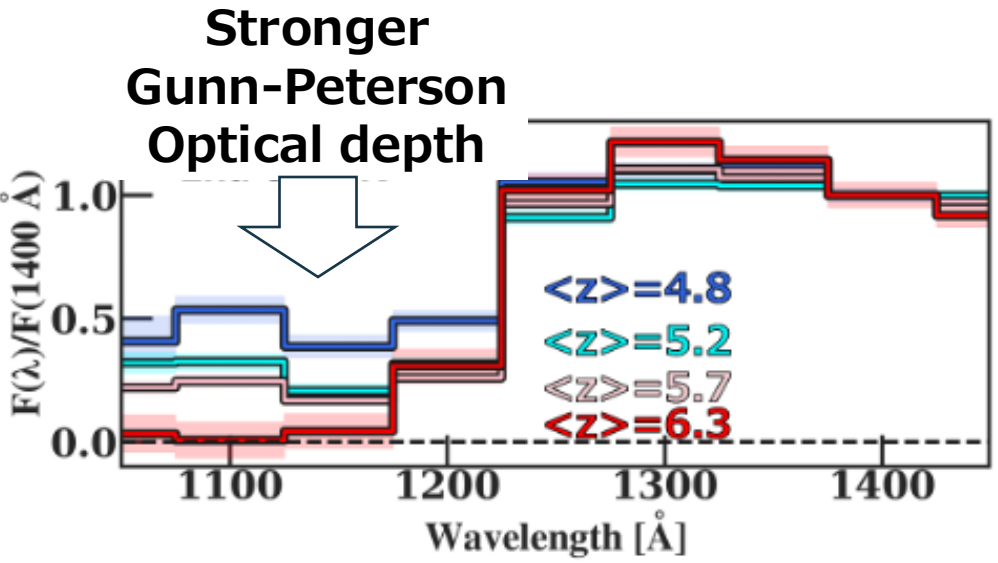

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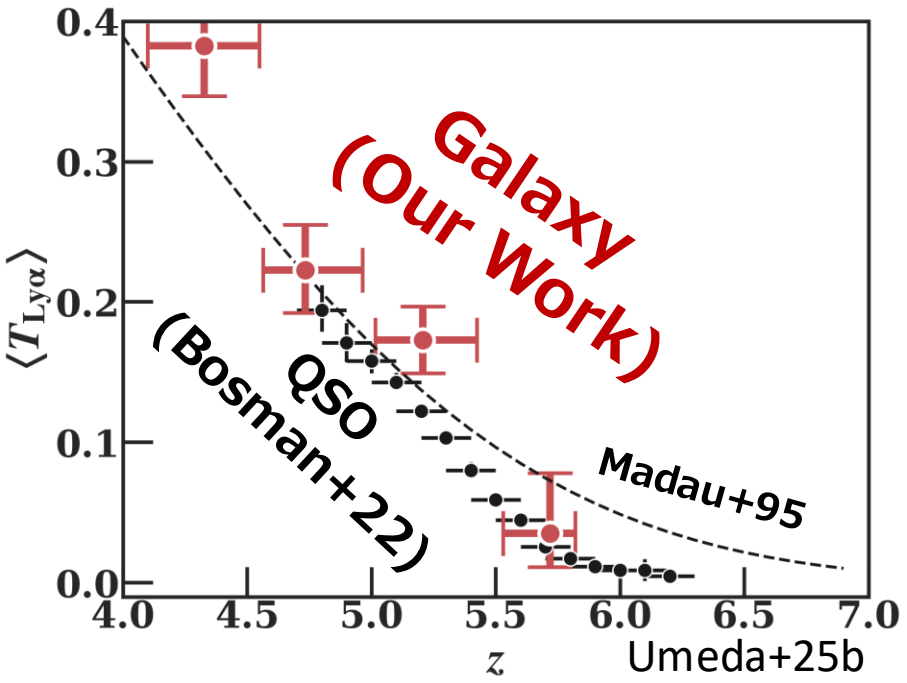

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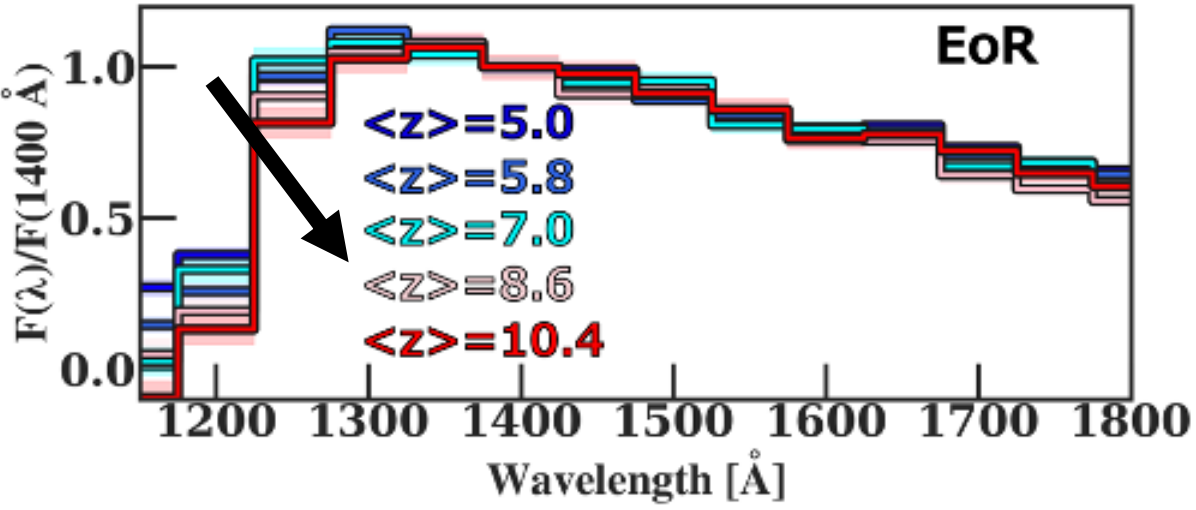
Deep Into EoR
Lya Break Evolution

Lyman Break Softening
Toward High-z



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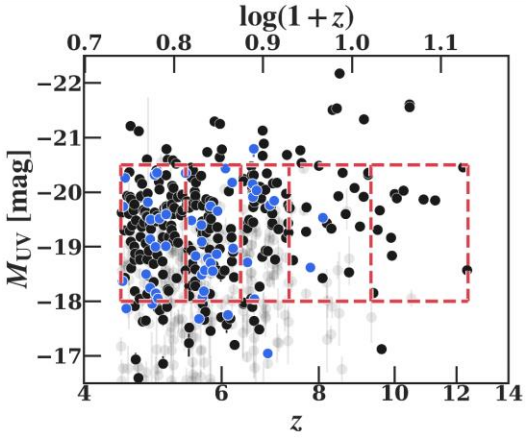

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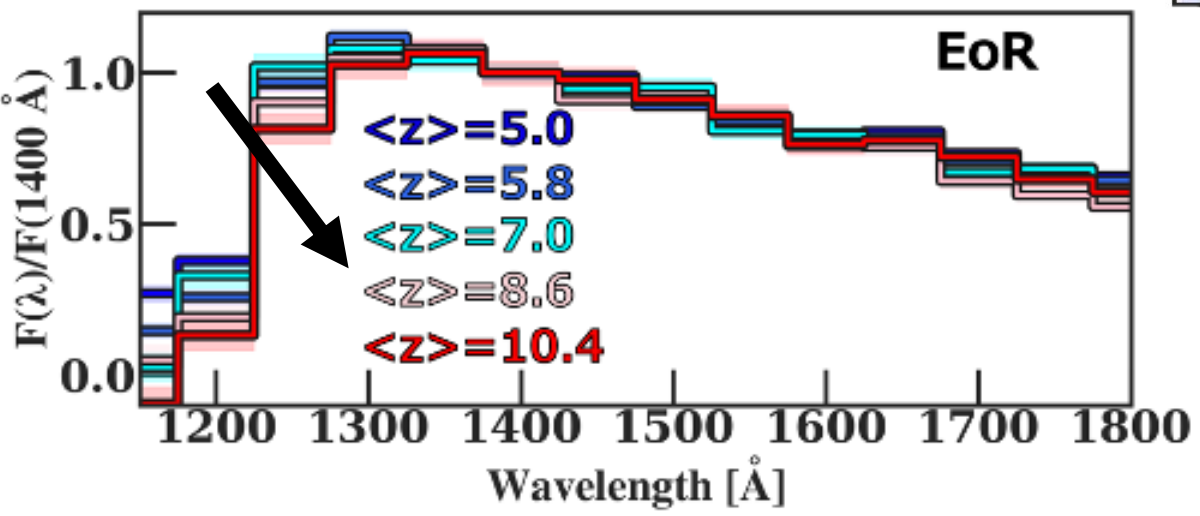

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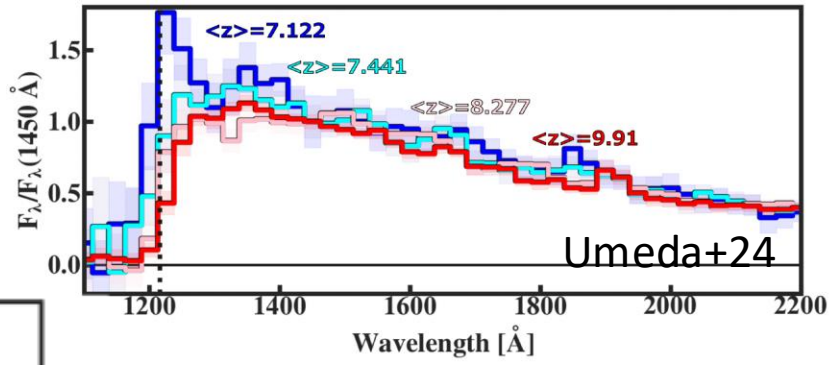

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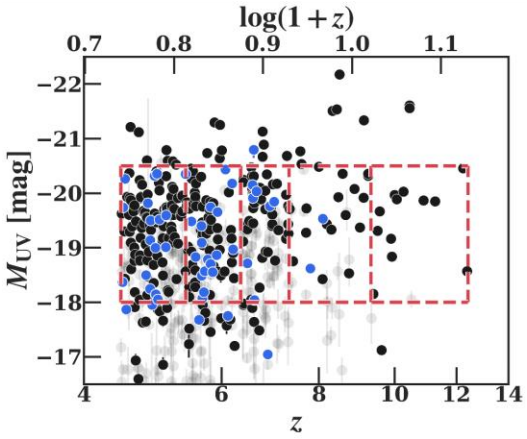
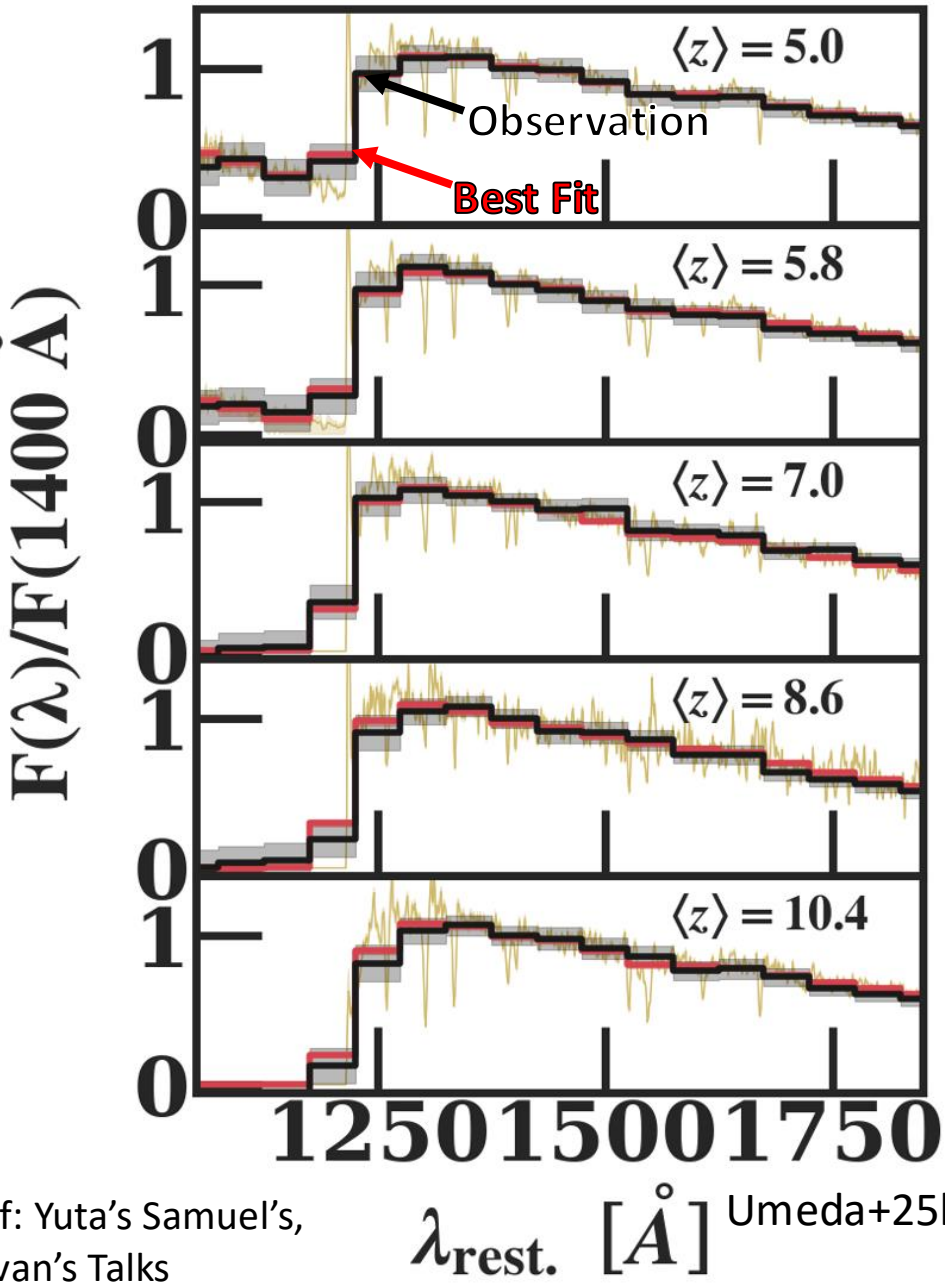


Umeda+25b

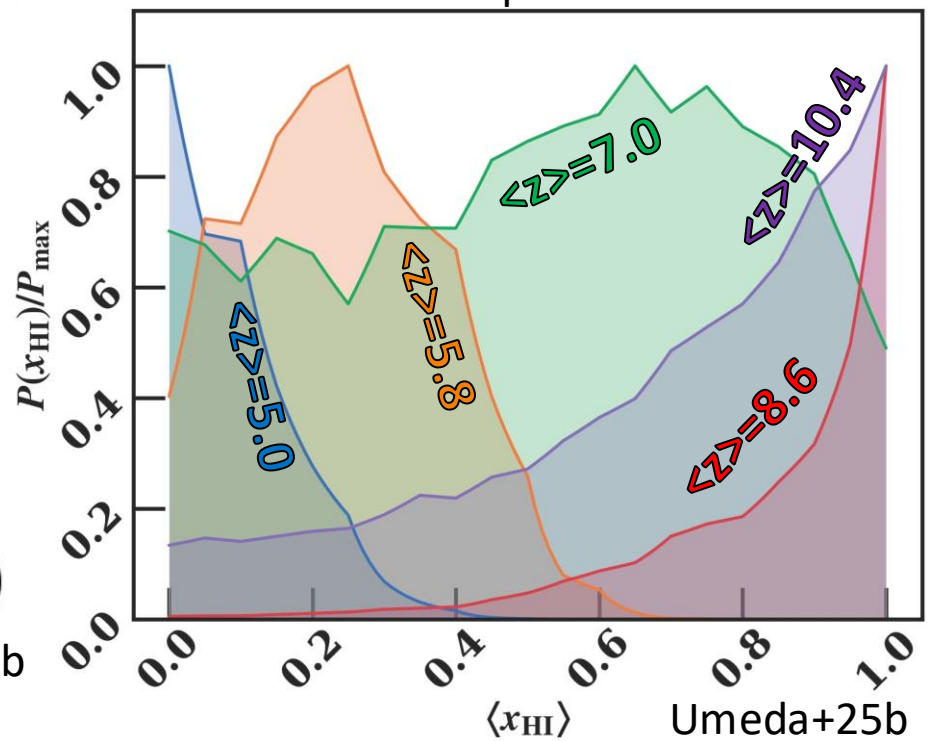
x_{HI} Inference

Mock Observations (cf. Yuta's Talk):
Sightline by Muv→Stack
IGM Model: 21cmFAST (Murray+20)
- Template Spectra: z~2-5 Galaxies (VANDELS; Cullen+19)
- Omit LAE-like sightlines (Mason+18)
- Residual HI Absorption Considered



cf: Yuta's Samuel's, Ivan's Talks

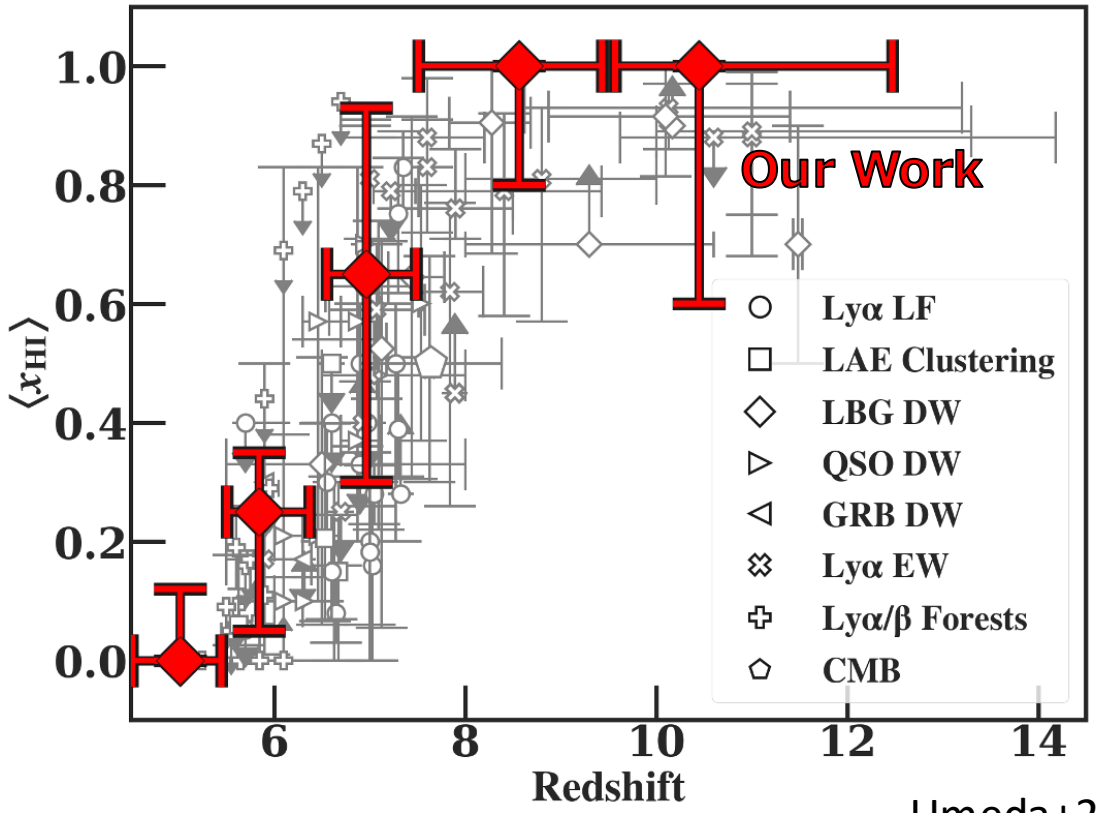
Umeda+25b



Umeda+25b

Overviewing Entire Cosmic Reionization History

✅ JWST Lyα Emission (Nakane+24, Kageura+25, Tang+24ab, Napolitano+24, Jones+24,25)



cf: Yuta's Samuel's, Ivan's Talks

Umeda+25b

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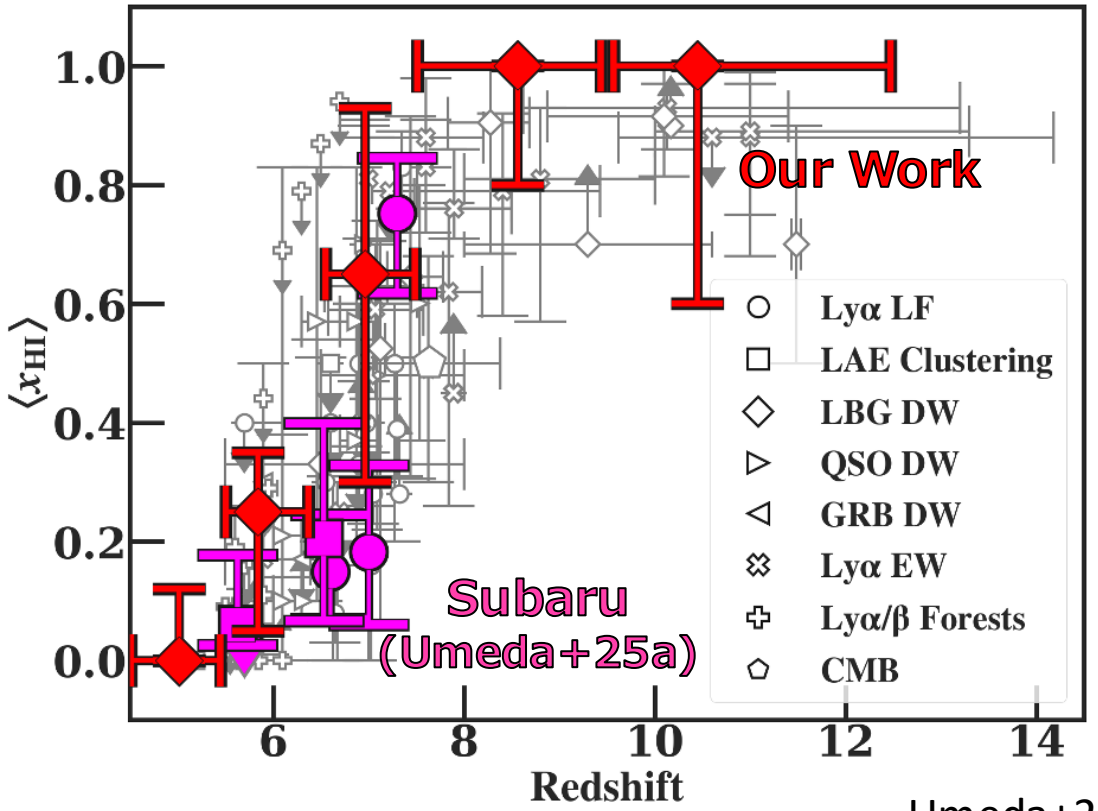

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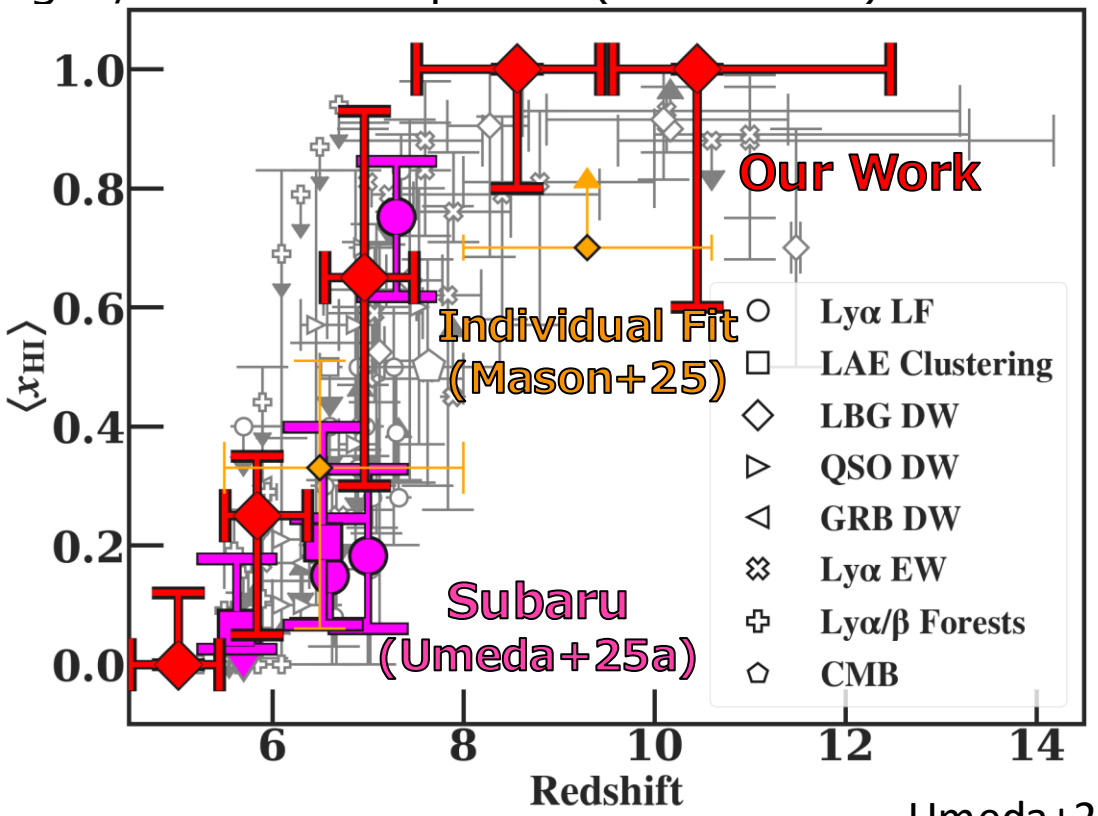
✅ DW Fitting w/ Individual Spectra (Mason+25)



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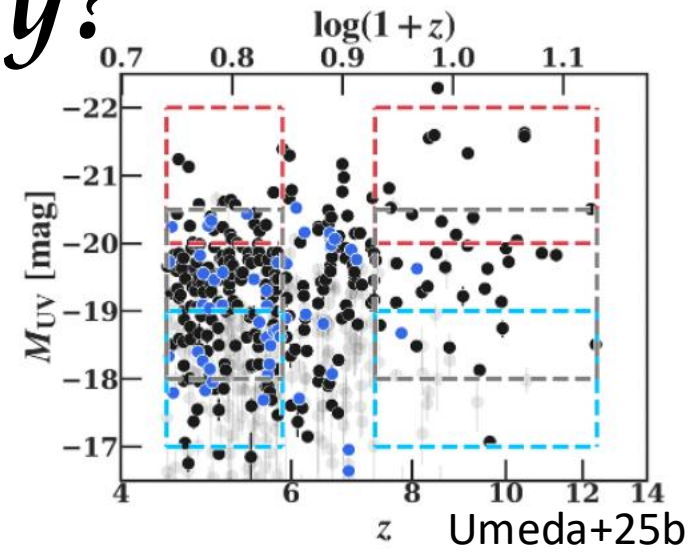
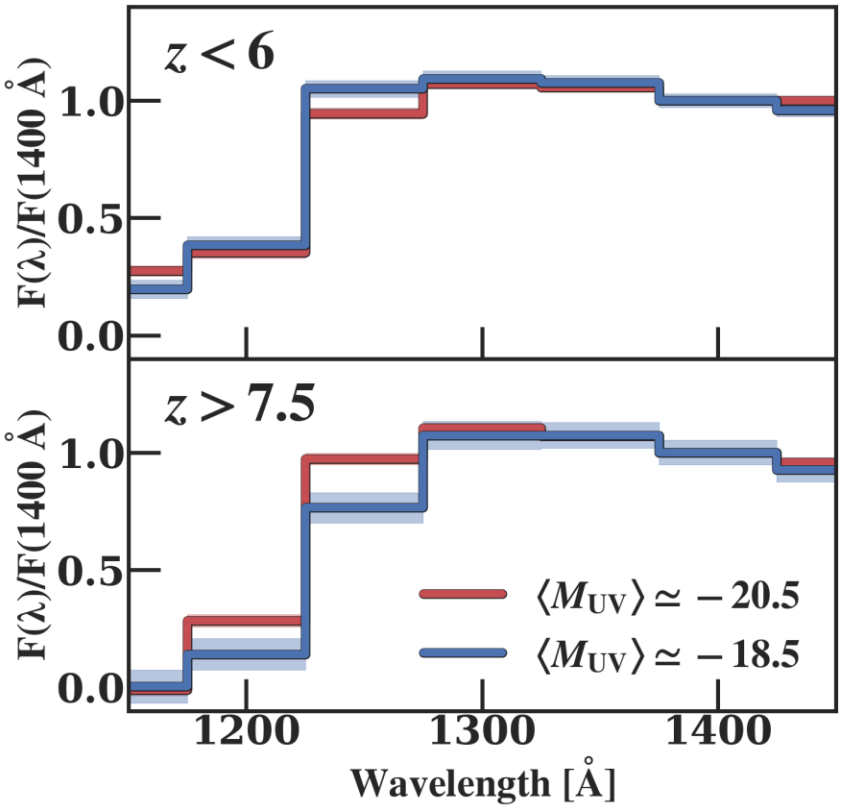
Umeda+25b

Topology?

Ionization Around Light/Massive Halo
→Topology of Ionized IGM



Umeda+25b



Umeda+25b

cf. Emma's Talk

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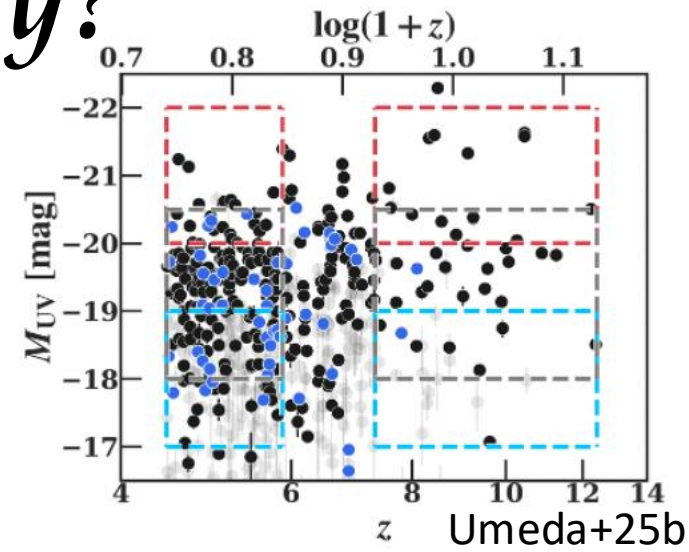
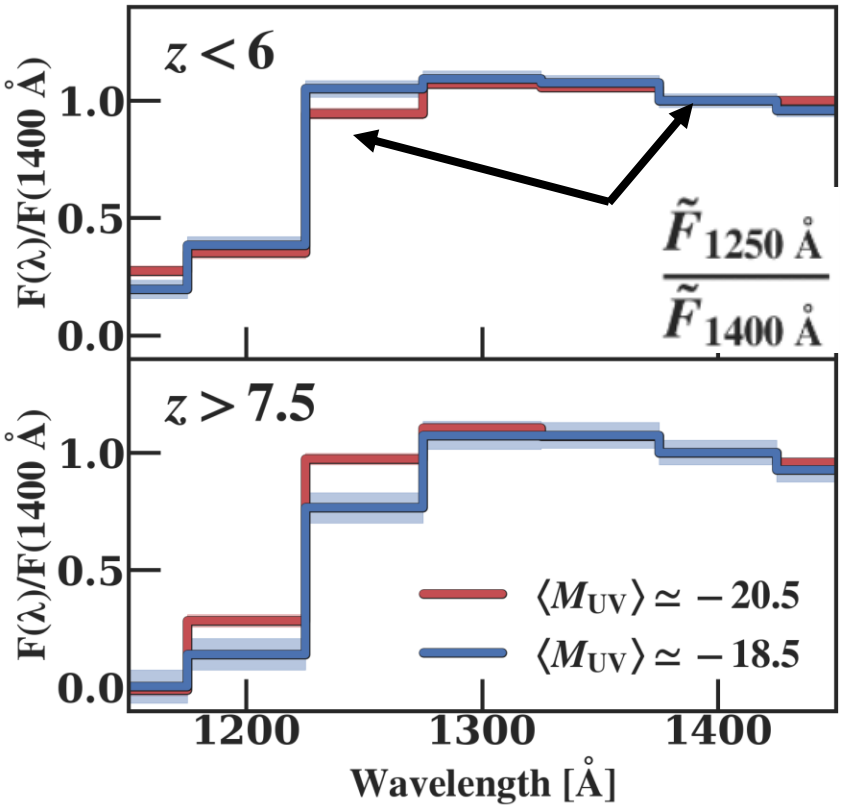


Umeda+25b



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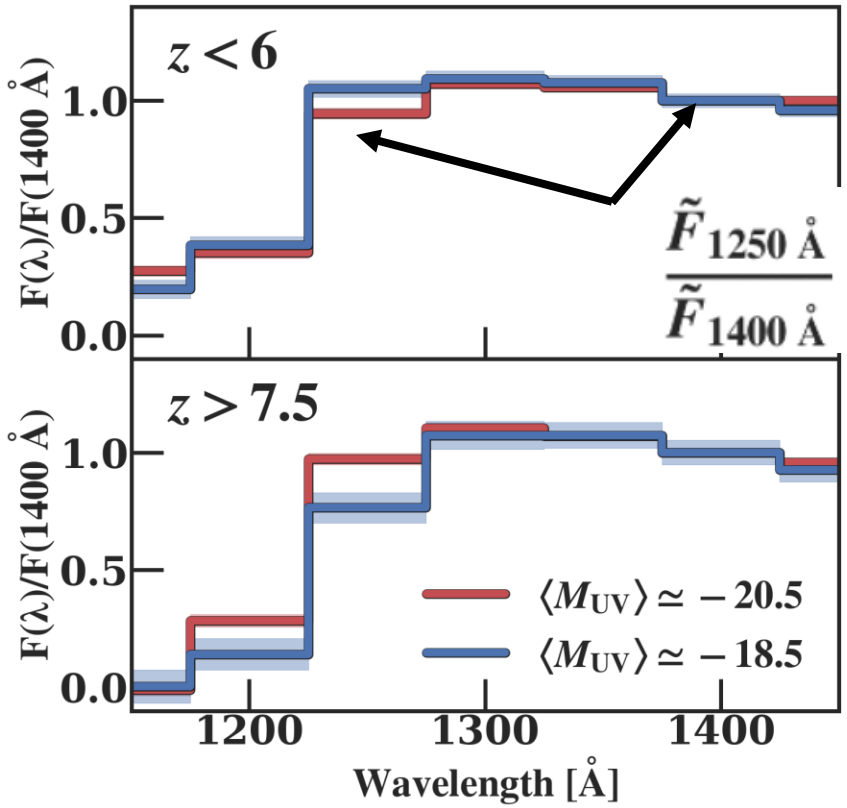

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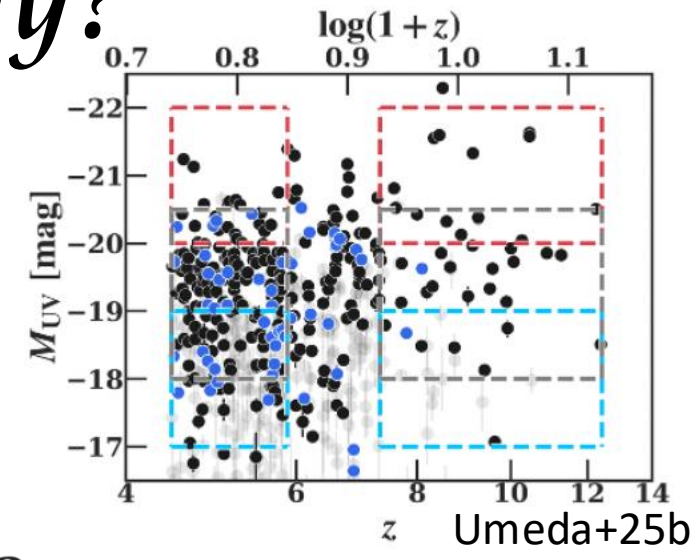

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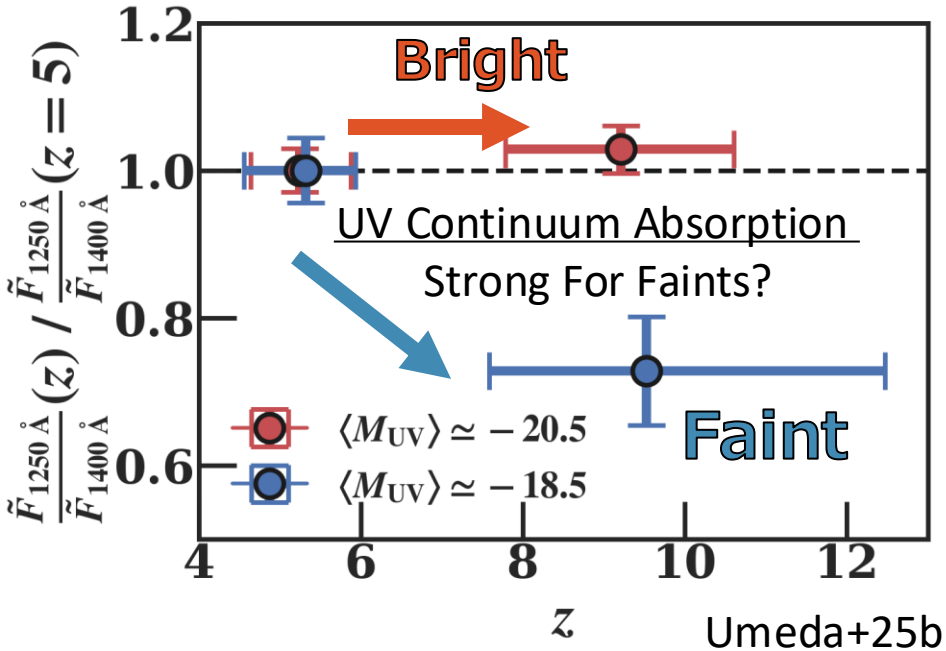

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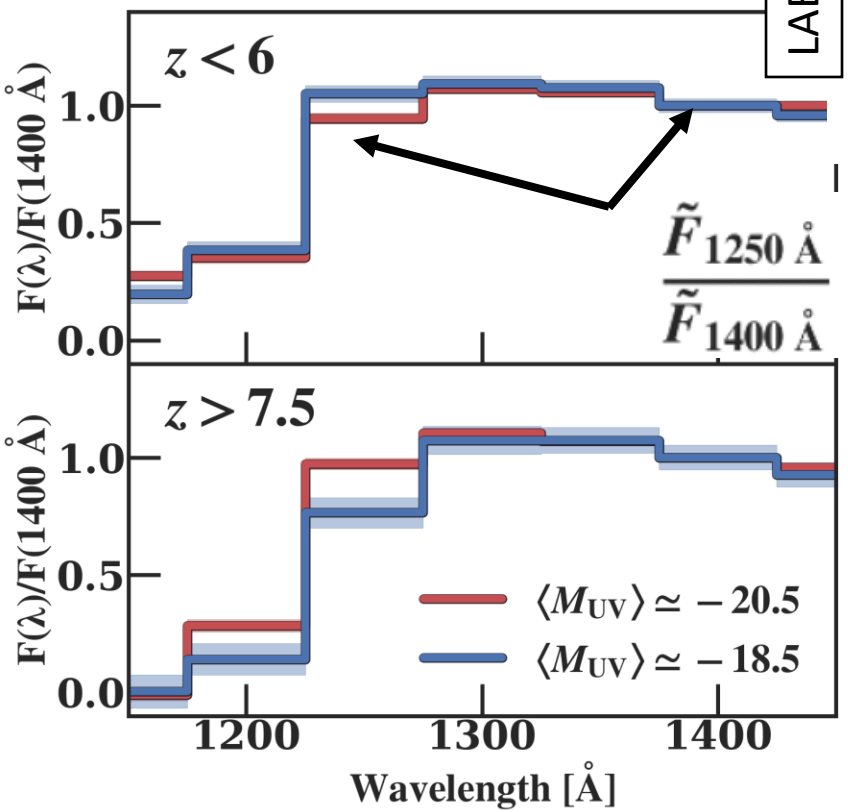
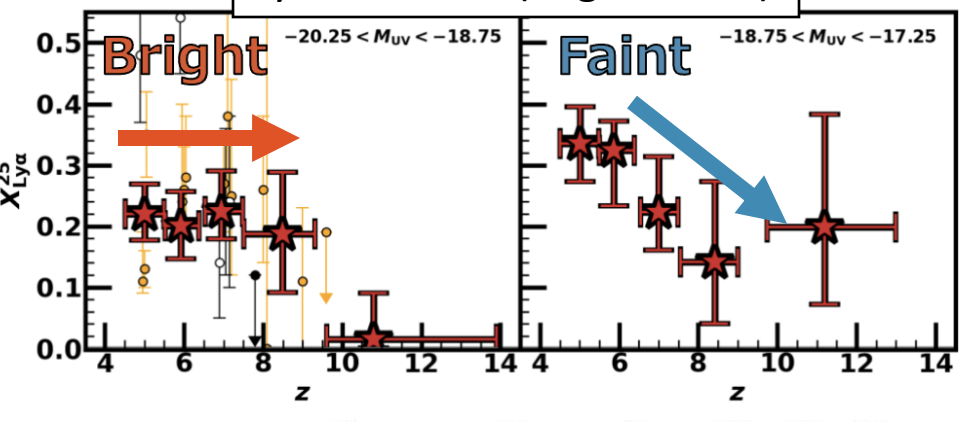


Umeda+25b

Lyα Emission (Kageura+25)



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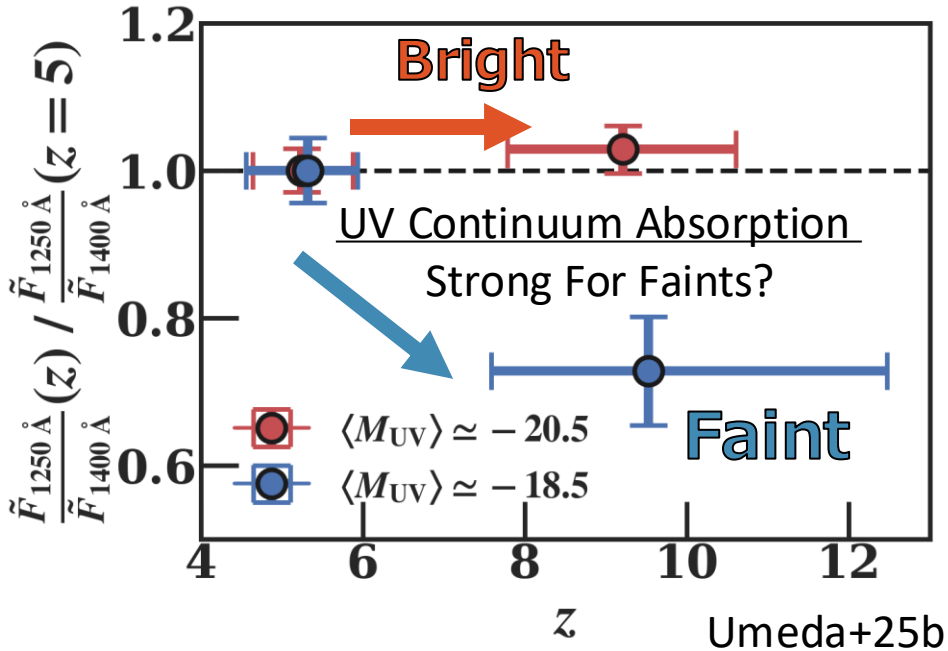

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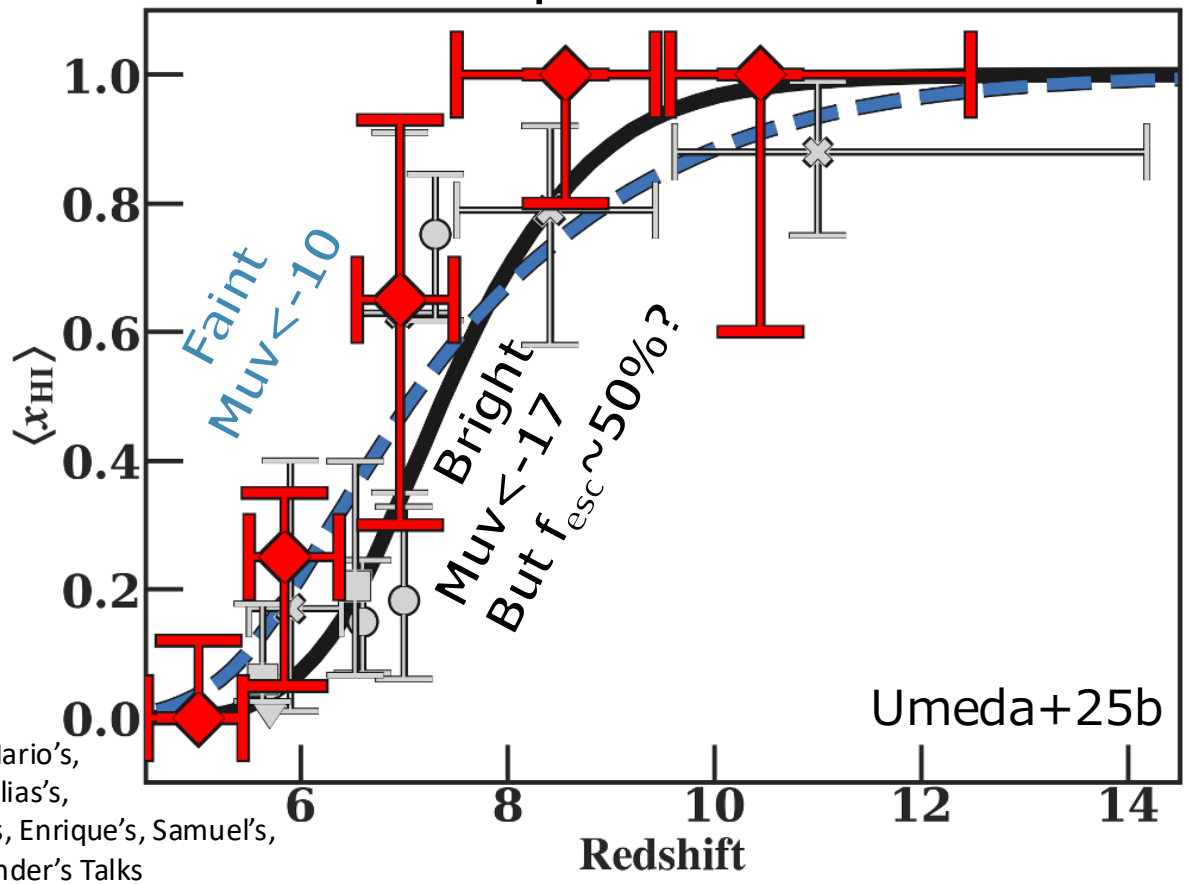
Cosmic Reionization Too Rapid and Too Late?

Continuum Absorption, Lyα EW, Lyα LF/Clustering

⇨ All Favors Too Rapid & Late Reionization?



cf. Andrea's, Charlotte's, Mario's, Eros's, Karla's, Valentin's, Illias's, Seonwoo's, Emma's, Juan's, Enrique's, Samuel's, Yuta's, Alessandra's, Alexander's Talks

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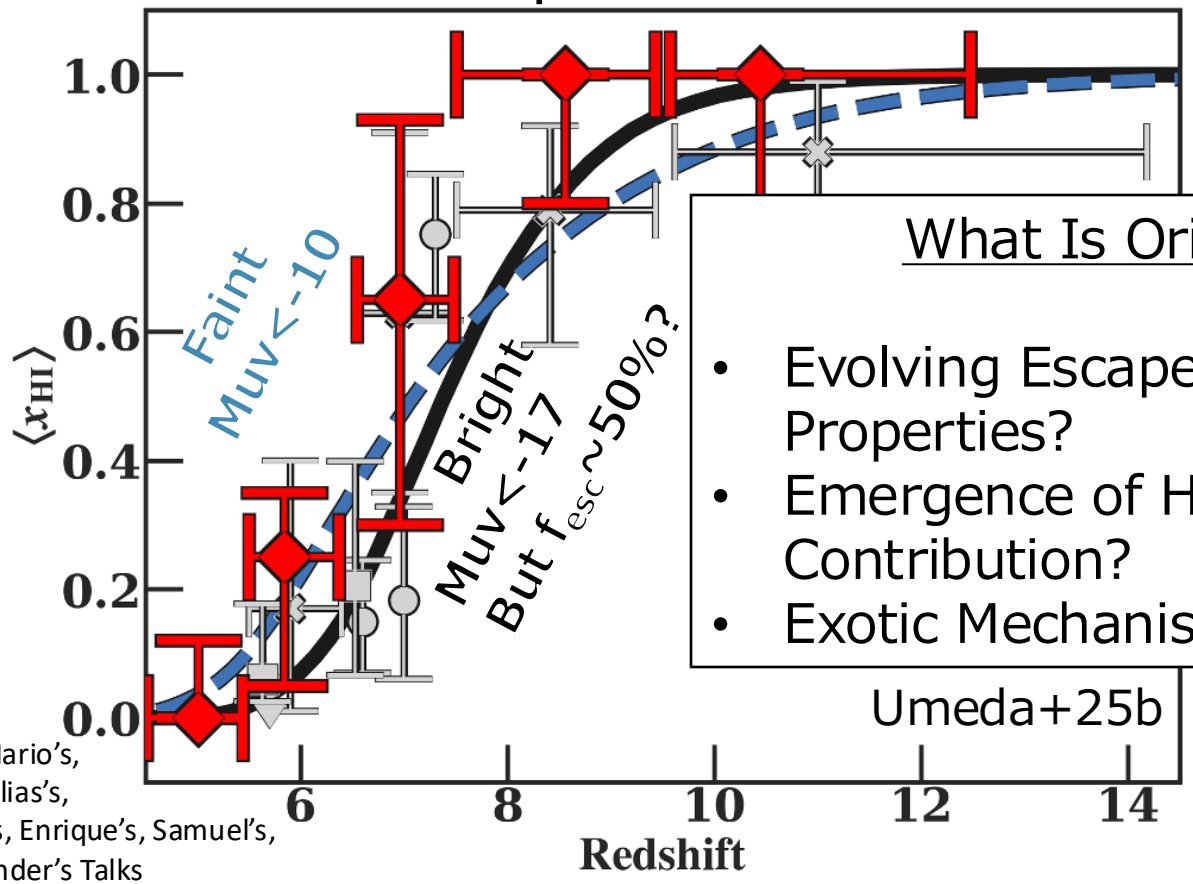


What Is Origin?

- Evolving Escape/Ionizing Properties?
- Emergence of Hidden AGN Contribution?
- Exotic Mechanisms??

Umeda+25b

cf. Andrea's, Charlotte's, Mario's, Eros's, Karla's, Valentin's, Illias's, Seonwoo's, Emma's, Juan's, Enrique's, Samuel's, Yuta's, Alessandra's, Alexander's Talks

Αποχωρώντας από την ομιλία

Up On arXiv This Week!

z<6: Gunn-Peterson Trough Strengthen

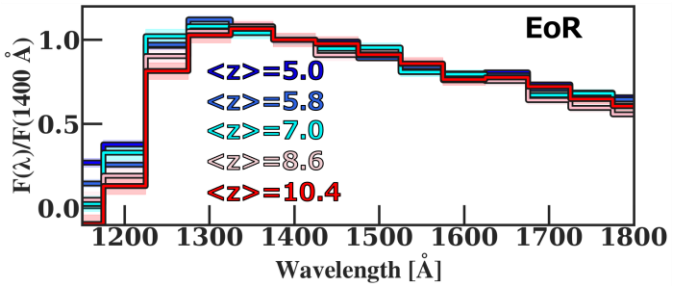
z>7: Lya Damping Wing Strengthen

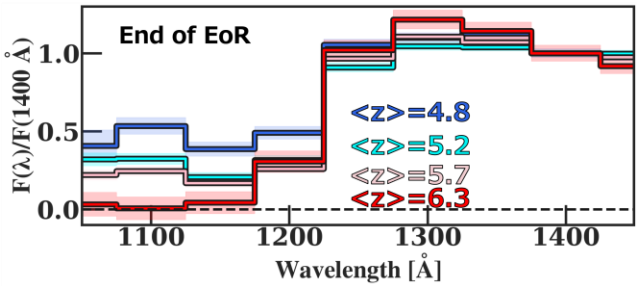
Dependencies on Galaxy Properties (UV magnitudes)

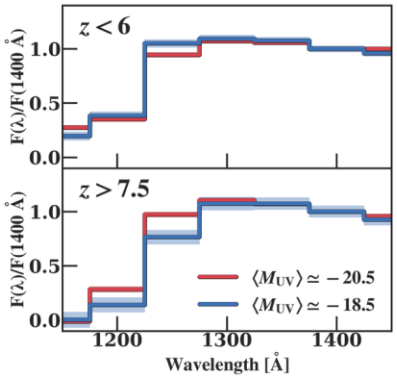
- *Bright Galaxies Dominant Driver of Cosmic Reionization?*

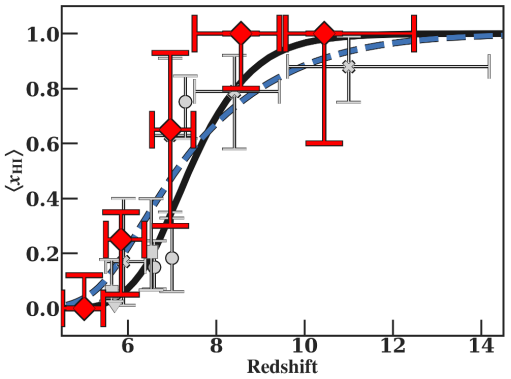
Rapid Reionization History Still Supported

- *Too Rapid & Late to Reproduce?*
- *Hidden Ionizing Sources Emerging at z~8?*
- *Evolving Escape Fractions / Ionizing Photon Production Efficiency?*
- *Any Ideas?*









Escaping from Job Hunting Labyrinth

FINISHING PHD! Job Market from Next Season!

If $\sigma_{\mathrm{interest}} > 0$ AND $\tau_{\mathrm{contract}} \gtrsim \mathrm{O}(1\,\mathrm{yr})$,

Please let me know!

Keywords:

Cosmic Reionization
Subaru
JWST
Lyα Emitters
High-z (z>7)

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