Exploring HI Density up to ~1 Mpc Around Lyman Alpha Emitters in HETDEX

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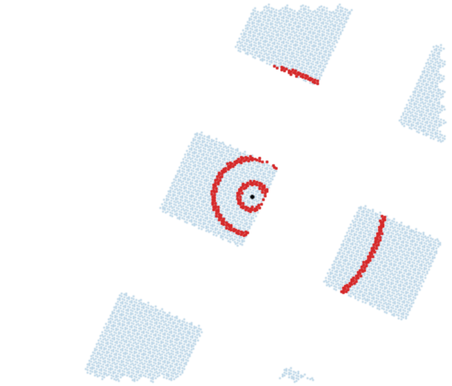
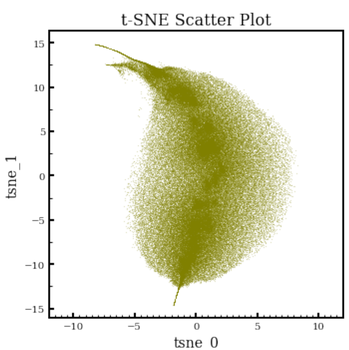
INTRODUCTION

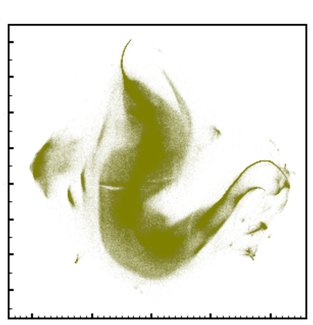
- Studying neutral Hydrogen (HI) gas distribution & kinematics near key sources like Lyman Alpha Emitters (LAEs) helps us with the evolution of large scale structures and the galaxies in them.
- HETDEX is an un-targeted integral field spectroscopic survey designed to measure the expansion rate of the universe at z~ 1.9-3.5 by mapping out 3D positions of ~1 million Lyman Alpha Emitters (LAEs).[1,2]
- Using data from HETDEX, we have selected LAEs to investigate HI column density around & between them through the Lyman Alpha Absorption Line.



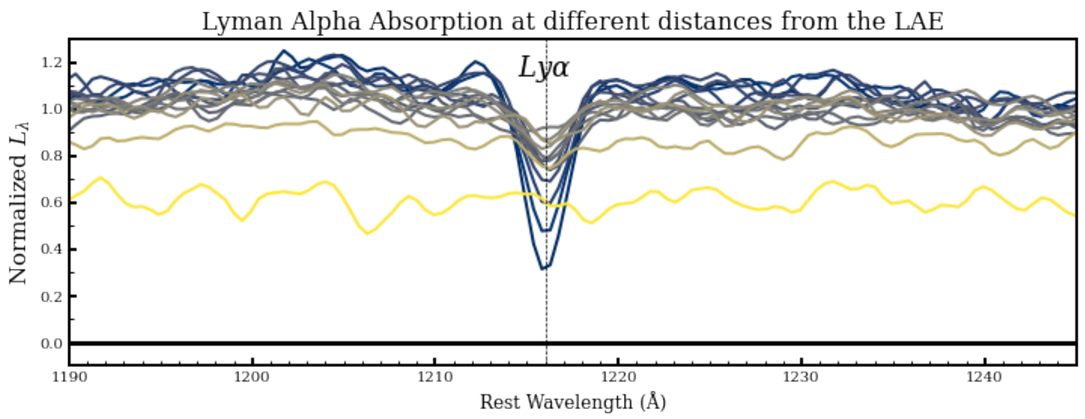
METHODS

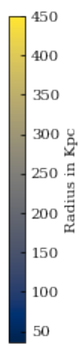
- We stack ~2 million spectra from ~55000 LAEs to boost the signal-to-noise ratio using the ELiXer software.[3]
- We stack LAEs in two ways: (1) Annulus around the LAE, (2) Regions in between LAE pairs.
- A machine learning pipeline (t-SNE) customized for HETDEX source catalog was designed for the analysis, ensuring a robust selection of LAEs, minimizing false positives.



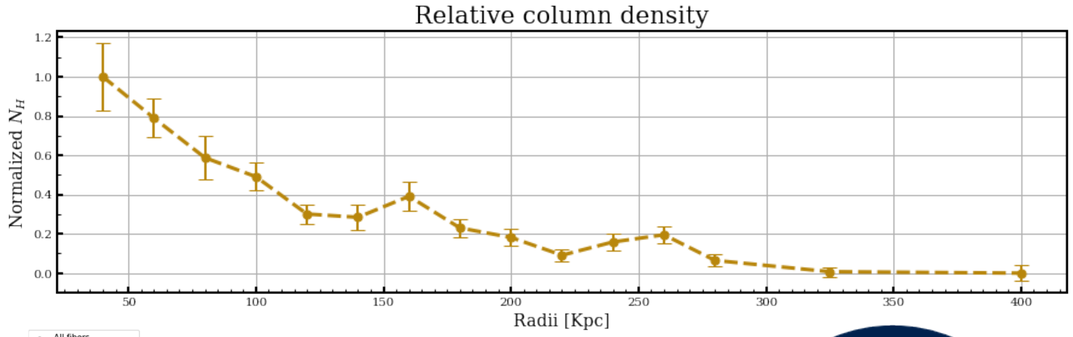


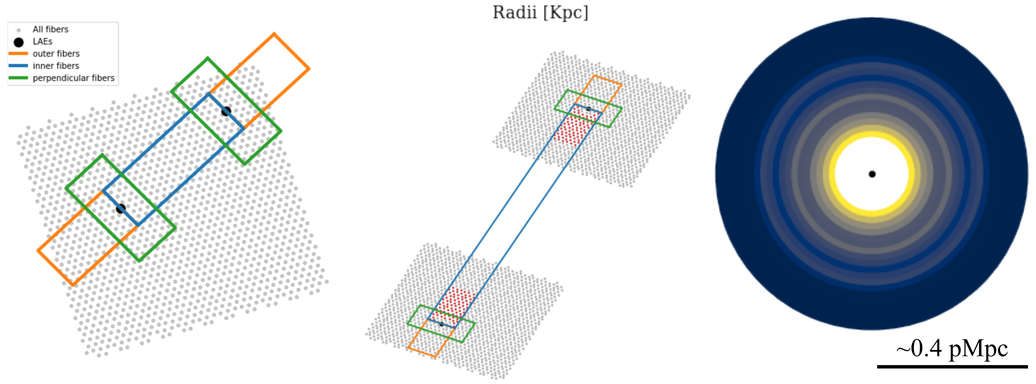
We provide an empirical density profile of HI around an average LAE at z ~ 2.6

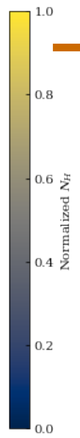


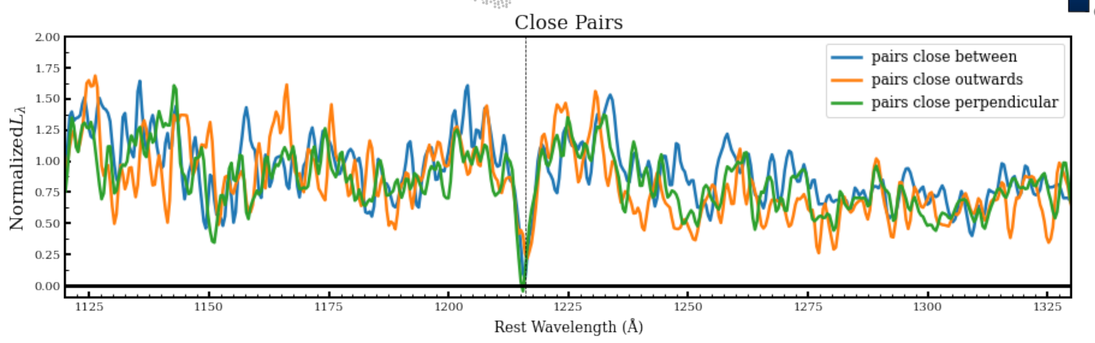


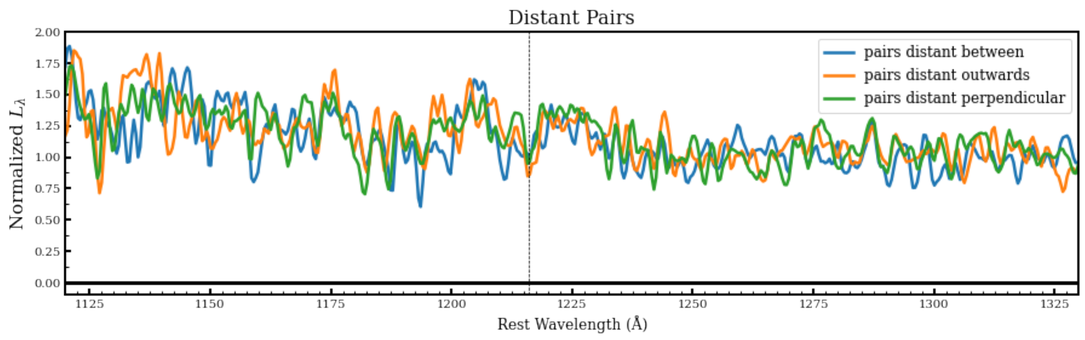
Relative column density











DISCUSSION

- We detect HI in absorption out to ~ 300 pKpc, as measured in annular regions surrounding the stacked LAE sample.
- We provide an empirical density profile of HI around an average LAE.
- We show that close pairs exhibit the strongest absorption by far, showcasing HI dense regions.
- This study deepens our understanding of the large scale structure and its gas constituents in the distant universe, bridging the gap between observational data and simulation models.
- With the interplay between LAEs and surrounding HI gas holding potential implications for the broader cosmological landscape, this work paves the way for in-depth research into their symbiotic evolution.

FUTURE WORK

- Binning based on redshift to understand the evolution of HI around LAEs.
- Finer binning of rings around LAEs to figure out the accurate size of HI around LAEs.
- See if we can find a way to get continuum values to give absolute column densities.
- Create a density profile for LAE pairs.

REFERENCES

1. Karl Gebhardt *et al* 2021 *ApJ* **923** 217
2. Erin Mentuch Cooper *et al* 2023 *ApJ* **943** 177
3. Dustin Davis *et al* 2023 *ApJ* **946** 86

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