TRACING CIV EVOLUTION IN HIGH-RESOLUTION QSO SPECTRA

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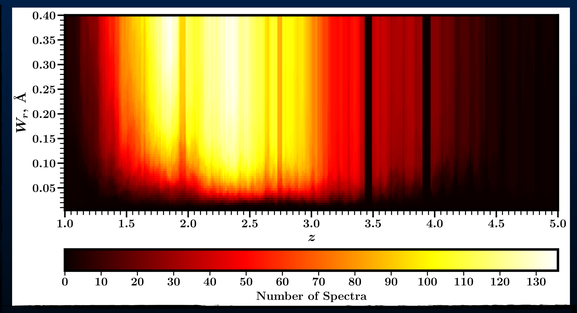
BACKGROUND

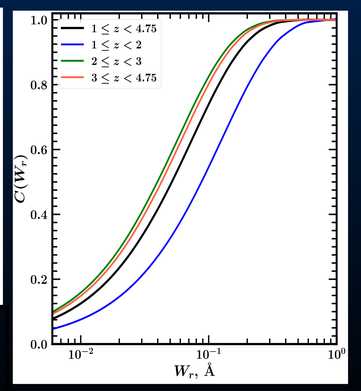
- Quasar (QSO) spectra reveal absorption by metals in the intervening media, tracing the baryon cycle that regulate galaxy evolution
- These absorbers are usually associated with galaxies where they originate
- High resolution (*R~45000*) spectra are needed to detect the weakest absorbers with equivalent widths $W < 0.3$ Å

SAMPLE

- In ~370 high-res QSO spectra from Keck/HIRES and VLT/UVES, we find ~1600 CIV absorbing systems at $1 \lesssim z \lesssim 4.75$
- The majority of these systems have $W < 0.3$ Å, allowing us to characterize the weakest population of metals in intergalactic space

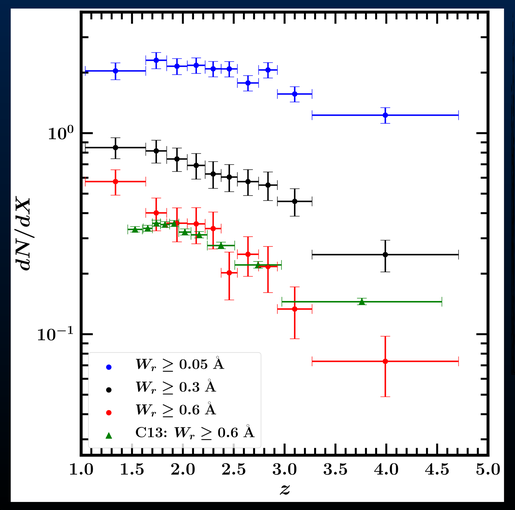
SENSITIVITY





Above: sensitivity as a function of redshift and equivalent width, *left*: completeness fraction as a function of equivalent width

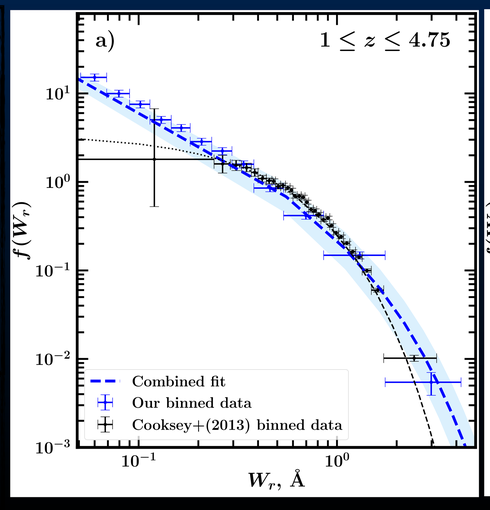
EVOLUTION OF CIV

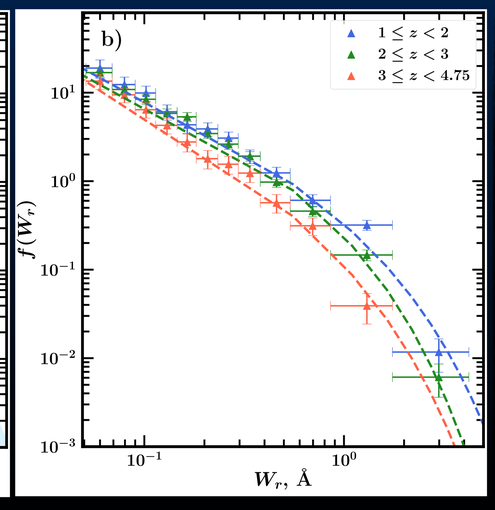


- dN/dX = number of absorbers per redshift path searched
- Generally, number decreases with redshift, but less evolution for weaker systems ($W > 0.05$ Å)
- Virtually no evolution of $W > 0.05$ Å systems at $z < 3$

Left: dN/dX evolution with redshift for different *W* cuts (blue, black, red); compared to Cooksey+(2013) (green)

DEMOGRAPHICS: FREQUENCY DISTRIBUTIONS





Left: Number of absorbers in each equivalent width bin, normalized to *dN/dX;*

a) Full sample, compared to Cooksey+(2013) and fit to Schechter function

b) Distributions for different redshift bins

PHYSICAL INTERPRETATIONS

- $\frac{dN}{dX} \propto n\sigma \implies n\sigma \sim constant$ for $W > 0.05$ Å systems
- Over time, galaxies have grown in size and have larger number densities, so how do these weak absorbers evolve so little while galaxies evolve so much?
- Strong absorbers ($W > 0.6$ Å) tend to live within 10s of kpc of galaxies, while $W > 0.05$ Å absorbers can live >200 kpc away
- Weakest absorbers likely a separate population in the intergalactic medium (IGM)

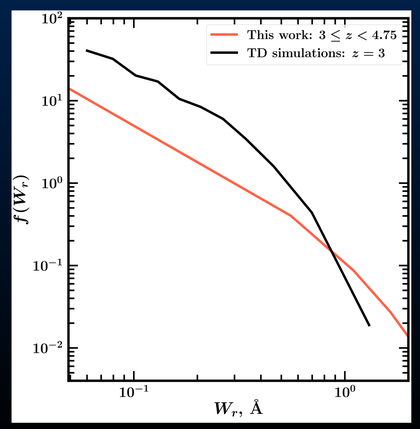
- Frequency distributions well fit by a Schechter function $\implies$ weak absorbers much more numerous; very strong absorbers rare

Evolution of CIV traces:

-History of enrichment by Carbon

-History of ionizing radiation

Left: Comparison with *Technicolor Dawn* simulations (Finlator+(2020))



This work uses the UVES SQUAD catalog (Murphy+(2019)), KODIAQ DR1 catalog (O'Meara+(2015)), and the catalog of Jessica L. Evans (Evans (2011))