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

SAMPLE

- Weakest absorbers likely a separate population in the intergalactic medium (IGM)
- Frequency distributions well fit by a Schechter function \( \Rightarrow \) weak absorbers much more numerous; very strong absorbers rare
- Evolution of CIV traces:
  - History of enrichment by Carbon
  - History of ionizing radiation

SENSITIVITY

- Sensitivity as a function of redshift and equivalent width, left: completeness fraction as a function of equivalent width

EVOLUTION OF CIV

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

DEMographics: Frequency distributions

- Left: \( \frac{dN}{dX} \) evolution with redshift for different \( W \) cuts (blue, black, red); compared to Cooksey+(2013) (green)

PHYSICAL INTERPRETATIONS

- 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 (\( W > 0.6 \, \text{Å} \)) tend to live within 10s of kpc of galaxies, while \( W > 0.05 \, \text{Å} \) absorbers can live >200 kpc away
- Weakest absorbers likely a separate population in the intergalactic medium (IGM)

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

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

b) Distributions for different redshift bins

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