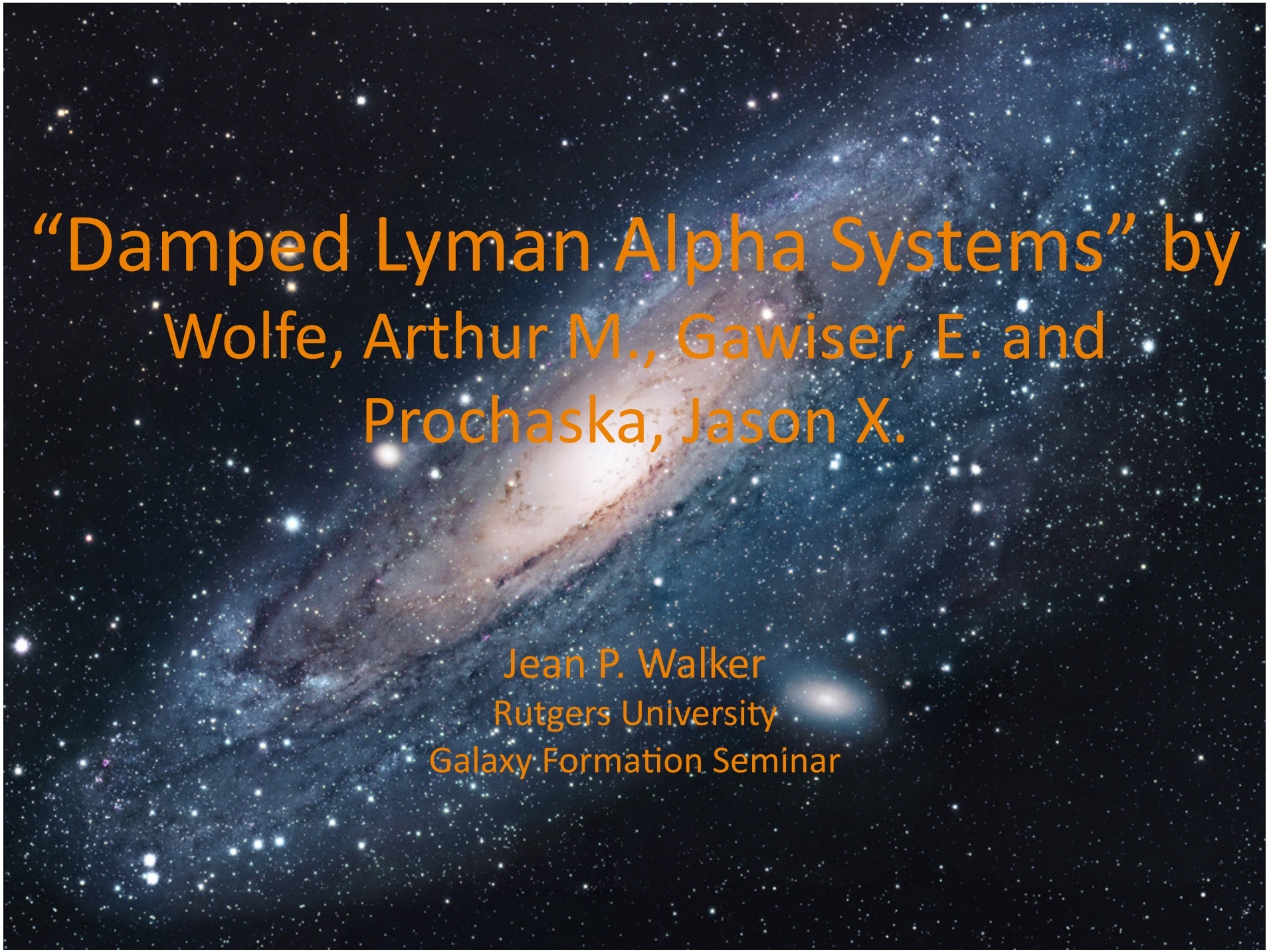


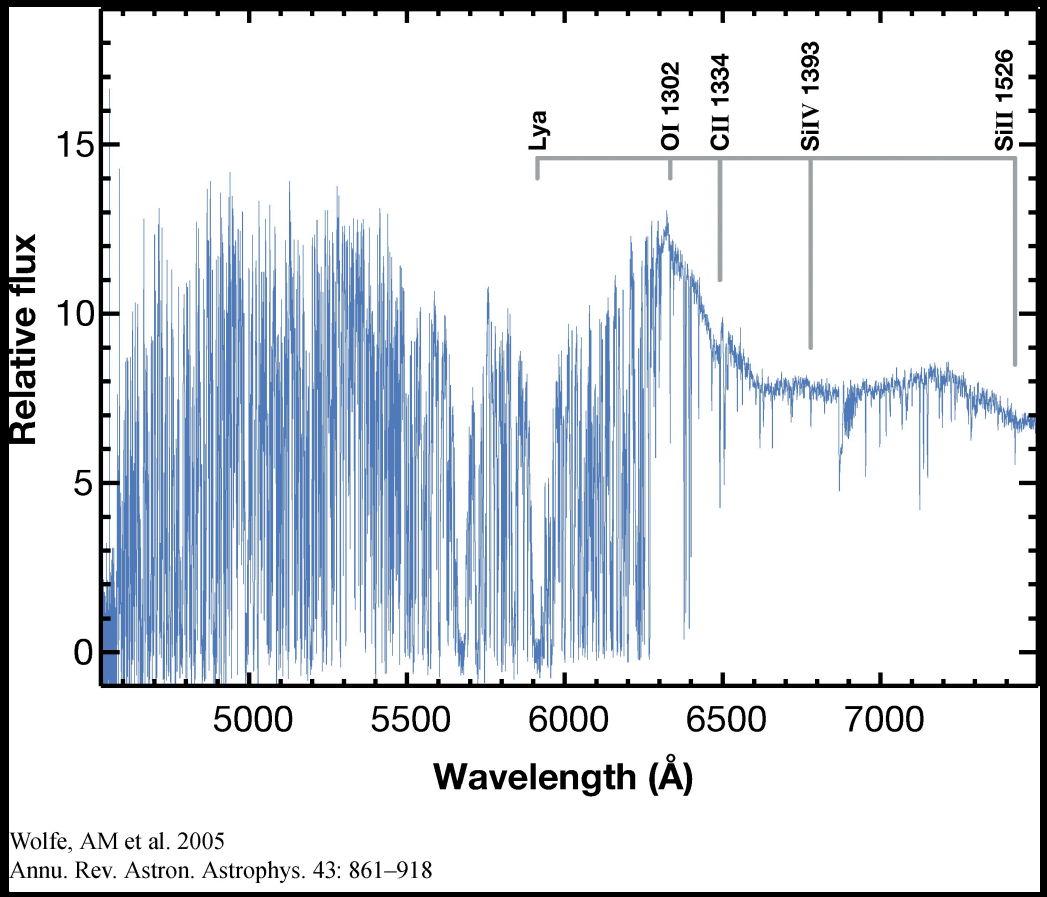
"Damped Lyman Alpha Systems" by Wolfe, Arthur M., Gawiser, E. and Prochaska, Jason X.

Jean P. Walker
Rutgers University
Galaxy Formation Seminar

Outline

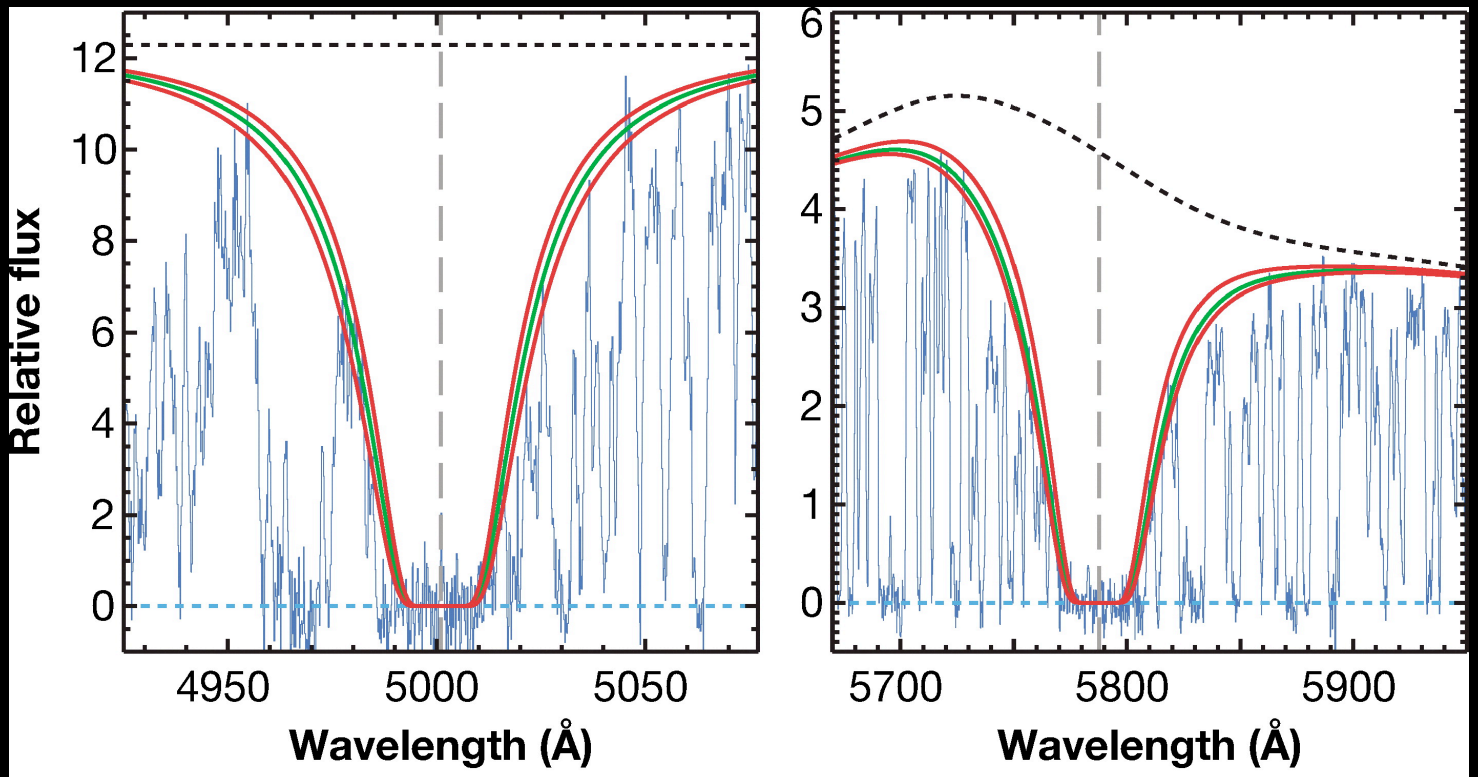
- What is a Damped Lyα system?
- How do you observe them?
- What is their nature?
- What do they contribute to galaxy formation?

What is a Damped Lyα system?: QSO Spectrum



QSO PSS0209+0517's spectrum. Fig. 1 from Wolfe et al. 2005

What is a Damped Lyα system?: Voigt Profile & the Damped Lyα Line



Wolfe, AM et al. 2005
Annu. Rev. Astron. Astrophys. 43: 861–918

Two DLAs with their best fit Voigt profile. Fig. 2 from Wolfe et al. 2005

How do you observe them?: Simple Observational Technique

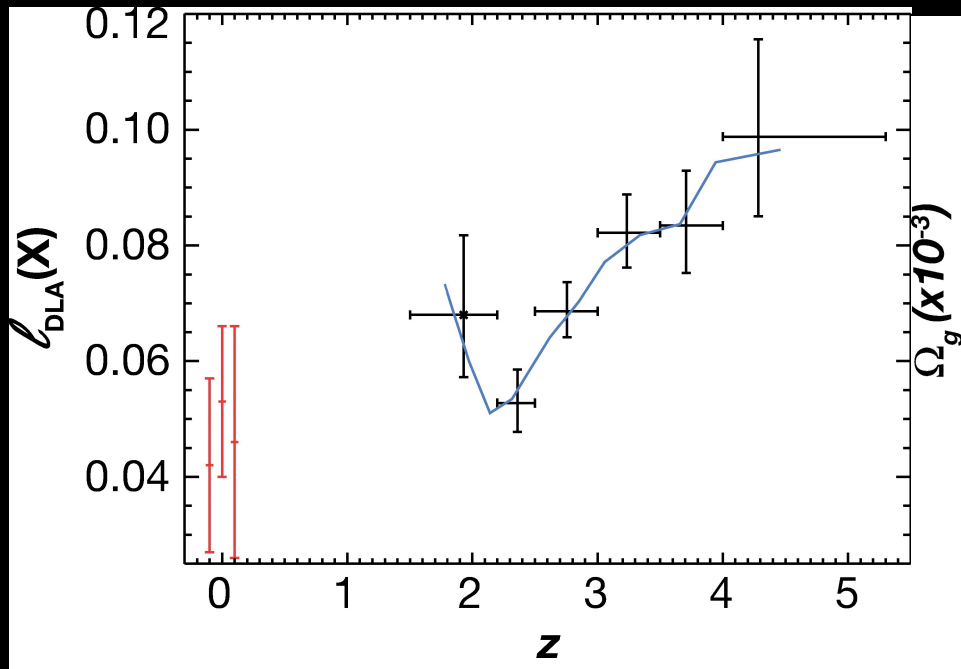
- $W_r \approx 10 * \sqrt{N(H[I])/2E20 cm^{-2}}$ Å
- $W_r > 5$Å, Limits selection to systems which fully absorb all QSO emission. Corresponds to $N(H[I]) \geq 5E19\ cm^{-2}$
- Search is done throughout $z=[z_{min}, z_{max}]$. Min. z was chosen to be where $\sigma(W_r) < 1$ Å. Max. z was chosen 3000 $km * s^{-1}$ below z_{em}.

What is their nature?: Properties

- By definition they are selected to have large amounts of H[I] gas, but they lack H_2 gas.
- DLAs are metal-poor objects with [M/H]≥-2.6 and <[M/H]>=-1.11
- The $\log_{10}$(SFR/Area) for a uniform disk is -1.95.
- DLAs have counterparts in other wavelengths, but any observations are plagued by the brightness of the background QSO.

What do they contribute to galaxy formation?: Cosmic Neutral Gas Measurements

- It has been shown that DLAs are good tracers of significant portion of H[I] in the universe from 1.6<z<5



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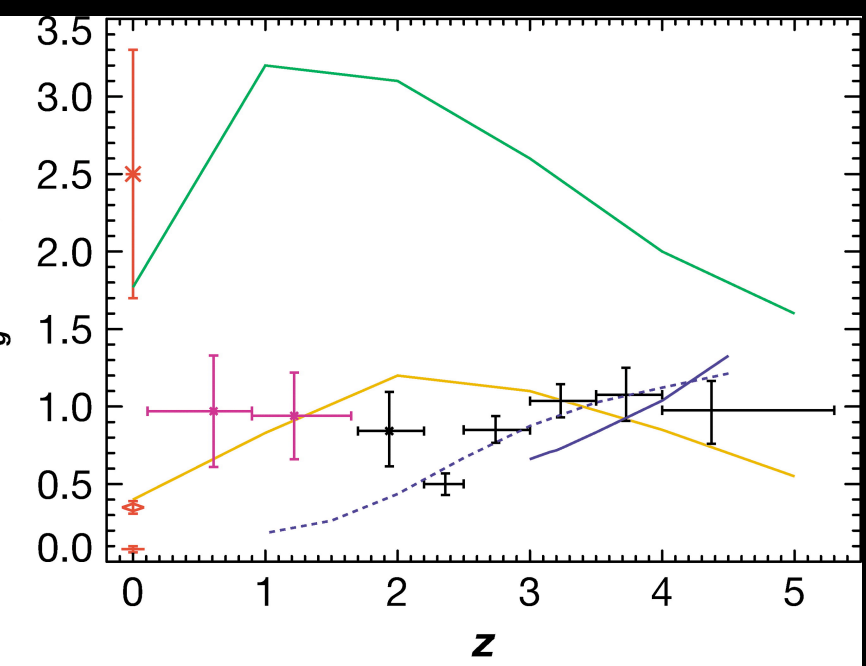

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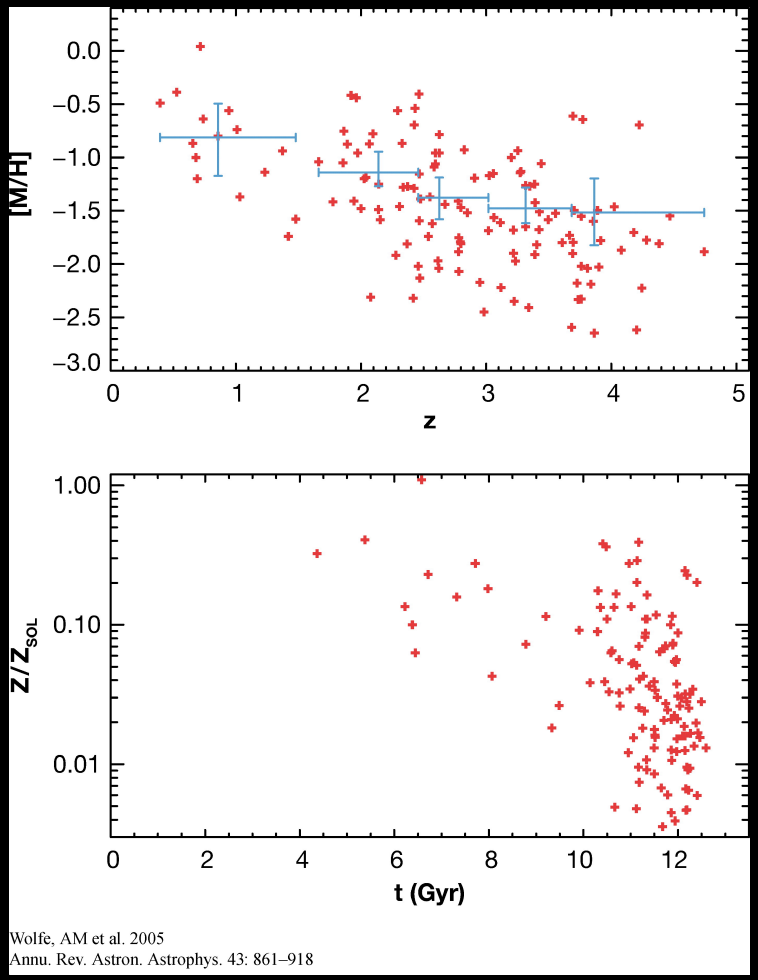
What do they contribute to galaxy formation?: Cosmic Neutral Gas Measurements



Wolfe, AM et al. 2005
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Evolution of DLA Metallicity Through Redshift.

- Evolution is toward Solar metallicity at present-day, but DLAs have metallicities which are sub-solar at low redshift.
- The DLA minimum metallicity is -2.6.

What do they contribute to galaxy formation?: Cosmic Neutral Gas Measurements

- DLAs provide the fuel for “future” star formation at galaxies at $2<z<5$.

- DLAs are thought to be the progenitors of the disk component of present-day galaxies. Though the evolution in metallicity towards present-day is sub-solar.

What do they contribute to galaxy formation?: Lack of Statistics & Understanding

- The calculation of a typical dark-matter halo mass is difficult because of statistics. Increased statistics can give the clustering and power spectrum for the H[I] distribution and improve estimates for b(z).

- There are indications that the luminosity function of DLAs overlaps with the LBGs luminosity function, but a lack of statistics creates an incomplete picture.

Conclusions

- DLAs are systems composed of H[I] which are detected by their absorption feature in QSO spectra.
- They are H[I] gas rich, while being H_2 poor and therefore is a great tracer of the hydrogen gas needed to fuel stars at later times.
- DLAs have low metallicities and contain a significant proportion of the H[I] gas found at $2<z<5$.
- They may be the progenitors of the disk* component of present-day galaxies.