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The Evolution of Lyα Absorbing Galaxies

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Abstract. The evolution of Lyα absorber counts is simulated for a model population of absorbing galaxies. The distribution of gas relative to galaxies could evolve between moderate and low redshifts, but constraints are needed on the strength and evolution of the ionizing UV background.

Lyα absorber observations at low to moderate redshifts constrain the evolution in the distribution of gas relative to galaxies. Absorber counts generally decrease with decreasing redshifts, although the decrease is less rapid at redshifts less than ~ 1.5 (Weymann et al. 1998). Such evolution has been explained by Davé et al. (1999) as largely the result of the decreasing UV ionizing background, assuming an ionization history based upon spectra from Haardt & Madau (1996). The evolution in Lyα absorber counts ($> 10^{14.3}$ cm^{-2}) is shown in Fig. 1, where I assume that such absorbers arise in galaxies at redshift $z = 0$ as simulated in Linder (2000) and Linder (1998). It is also assumed that at at each simulated redshift a population of galaxies with the same gaseous properties exists, and that the ionizing background radiation evolves as in Davé et al. (1999). At higher redshifts weaker absorbers are included, assuming that absorbers at a given column density correspond to a smaller overdensity at a higher redshift, as shown in Fig. 10 of Davé et al. Reproducing the observed evolution at high redshifts will require understanding both the cosmology and the large scale process of formation of gas into galaxies. Yet it is interesting to look at the evolution of absorber counts due to galaxies at the lowest redshifts. While qualitatively similar evolution (steeper at higher redshifts) is seen here as in Weymann et al. (1998), one curious feature in this model is that the absorber counts increase from $z = 0.5$ to $z = 0$.

What could be happening in this redshift range? In the simulations illustrated in Fig. 1 it is assumed that the total (neutral plus ionized) gaseous extent of galaxies remains constant with redshift. There could be evolution as a result of the formation process of gas into galaxies, although it seems surprising that so much formation would be happening at $z < 0.5$. It is also possible that there are as many nongalactic absorbers at $z \sim 0.5$ as at $z \sim 0$, where a given absorber is more weakly associated with a galaxy yet more highly ionized. In this case no evolution might be detected in the gaseous extent of galaxies, as for example Chen et al. (2000). Another possibility is that the UV ionizing background could decrease less quickly than estimated from the Haardt & Madau (1996) models.

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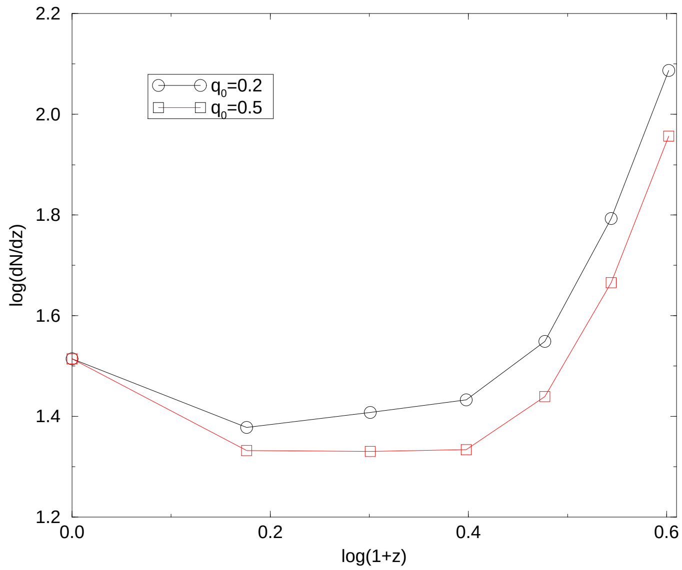

Figure 1. The number of Lyα absorbers ($> 10^{14.3}$ cm^{-2}) per unit redshift is shown versus redshift. All absorbers at $z \sim 0$ are assumed to arise in gas extending from galaxy disks. Absorber counts may actually increase after $z \sim 0.5$ unless the ionizing background decreases more slowly or the average gaseous extent of galaxies decreases rapidly.

This seems plausible as only quasars are included in their spectra, while some evidence is seen that gas surrounding galaxies is ionized by the galaxies themselves (Bland-Hawthorn et al. 1997). Yet it is likely that there is some evolution in the UV ionizing background and in the observable properties of galaxies, so that a more complex evolutionary process is happening than that reported by Chen et al. (2000). One possibility is that absorber counts actually do increase at $z \sim 0$, where it is most difficult to get an adequate sample of absorption line data. In this case there would be more HI in the local universe than what we have been extrapolating from absorber counts at slightly higher redshifts.

The nature of absorbers could change quickly between moderate and low redshifts, but at this time we know little about the strength or evolution of the ionizing UV background. The strength of this background typically changes rapidly in simulations over the range of $z \sim 0$ to 0.8, where observers tend to look for the averaged relationship between galaxies and 'low redshift' absorbers.

References

Bland-Hawthorn, J., Freeman, K. C., & Quinn, P. J. 1997, ApJ, 490,143

Chen, H.-W., Lanzetta, K. M., & Fernandez-Soto, A. 2000, ApJ, 533, 120

Davé, R., Hernquist, L., Katz, N., & Weinberg, D. 1999, ApJ, 511, 521

Haardt, F. & Madau, P. 1996, ApJ, 461, 20

Linder, S. M. 1998, ApJ, 495, 637

Linder, S. M. 2000, ApJ, 529, 644

Weymann, R. J. et al. 1998, ApJ, 506, 1