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The Evolution of Moderately Ionized Gas in the Universe

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Abstract. We present results on the properties and evolution of moderately ionized gas in the Universe based on intervening CIV absorption-line systems. We have compiled a database of CIV systems from the SDSS, and we find evidence for evolution in the incidence of CIV absorbers.

Keywords. quasars: absorption lines, galaxies: evolution

Gaseous regions distributed throughout the Universe can be studied by observing the absorption signatures they produce in background quasar spectra. We have used this method to study the properties of moderately ionized gas in the redshift interval $1.5 < z < 4.2$, spanning 11% − 32% of the age of the Universe. Our sample consists of ∼ 15,000 quasars selected from the SDSS DR3 (Abazajian *et al.* 2005). We have searched the quasar spectra for the CIV $\lambda\lambda$1548,1550 absorption doublet.

We have measured the redshifts and absorption line properties of ∼5600 CIV doublets. The CIV λ1548 absorber incidence per unit redshift, $\partial N/\partial z$, is proportional to the product of absorber gas cross-section and the comoving number density. The results on $\partial N/\partial z$ (Figure 1) indicate that in a relatively short period of cosmic time (∼1.1 Gyr) the product of these two quantities increased by a factor of ∼2 as the Universe evolved from z∼3 to z∼2, i.e., from 2.2 Gyr to 3.3 Gyr after the Big Bang. This may correspond to a significant epoch of metal enrichment by supernovae-driven galactic fountains.

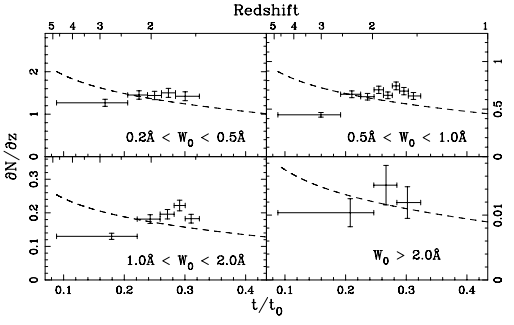

Figure 1. CIV λ1548 incidence, $\partial N/\partial z$, for different rest equivalent width, W_0, intervals vs. the fractional age of the Universe (t/t_0). The dashed curve is the no-evolution prediction using $\Omega_m = 0.27$ and $\Lambda = 0.73$. For the sensitive measurements at 0.5 Å $< W_0 <$ 2.0 Å, a factor of ∼2 increase in $\partial N/\partial z$ occurs between redshifts 3 and 2 during ∼1.1 Gyr.

These results were derived from Sloan Digital Sky Survey data (see www.sdss.org for credits and participating institutions).

Reference

Abazajian, K., *et al.* 2005, *AJ* 129, 1755