The ultraviolet Spectrum of HS1700+6416 revisited

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Abstract. New UV spectra of the bright (V = 16.1), high redshift ($z_{em} = 2.72$) quasar HS1700+6416 with improved S/N = 10..20 covering most of the range between 1150 Å and 2330 Å have been taken with the GHRS (resolution FWHM = 0.77 Å) and the FOS (1.44 Å). In the light of recently published, high resolution optical data, they are analyzed with particular emphasis on neon and sulphur abundances as well as absorption systems at lower redshifts.
Observed column densities for a wide variety of ions provide useful constraints for 2-component cloud models consisting of a high and a low density phase photoionized by a metagalactic radiation field.
Discrepancies between predicted and measured column densities for high-ionization species (O VI, Ne VII, Ne VIII) observed at higher redshift can be overcome by the application of a harder ionizing field. This modification, though, leads to only slightly different heavy element abundances.
Since a high metallicity of the strongest component of the absorber complex at $z = 2.315$ has been derived from optical data by Tripp et al. [4], their model has been checked for consistency with results from the new UV data.

1 Results

1. Absorption Systems: A new MLS at $z = 0.09$ has been found on the basis of strong but blended absorption for Lyα and the C IV doublet. This redshift coincides well with $z = 0.086$ of a galaxy detected at $11''$ (i.e. $\sim$30 kpc; $H_0 = 50$ kms^{-1}/Mpc) from HS1700 by Reimers et al. [3].

2. Photoionization Models: Assuming photoionization, cloud models under the influence of a metagalactic radiation field as computed by Haardt & Madau [2] for different redshifts have been constructed with Ferland's ionization code CLOUDY [1]. The cloud models consist of two regions of different hydrogen density : low- (LIP) and high-ionization phase (HIP).
In some cases these models fail to produce sufficient amounts of highly ionized elements (O VI, Ne VII, Ne VIII). If the corresponding measured column densities are real, a harder radiation field obtained by decreasing the He II-edge by a factor of 3 leads to adequate amounts of highly ionized elements. This modification, though, has no significant effect on the metal abundances, apart from neon, for which a slightly larger value has been found.

3. The Absorber Complex at $z = 2.315$: Tripp et al. [4] derive [M/H] $= -0.45$ for the strongest component of this system from a one-phase cloud model. Adopting their model, we were not able to reproduce the wide variety of different ionization stages observed in the new UV data, which suggests the introduction of an additional HIP. Information from UV data of higher resolution are required to derive precise metal abundances, but prominent absorption by various ions including S III and Ne IV and correspondingly high observed metal column densities indicate the possibility of a high metallicity of this system.

4. Evolution of Metal Abundances with Redshift: In general, metal abundances increase with decreasing redshift with [M/H] ≈ -2 at $z = 2$, [M/H] ≈ -1 at $z = 1$ and values slightly below solar at $z = 0.5$ (see Table 1). The investigation of the system at $z = 2.315$, however, indicates, that exceptions from this trend do occur. If the measured column densities of high-ionization species are real, neon abundances would be greater by $\sim$0.3 dex (higher [Ne/H] value is given in parentheses).
Except for the absorber at $z = 0.8643$, no significant overabundance of O and N relative to C as compared with solar values has been found. According to the models, though, Si, Mg, S and in particular Ne are enriched relative to C. However, unresolved saturation of the strong C, N and O lines and/or unrecognized blending of Si, S and Ne lines might result in an artificial enrichment of the latter elements.

Table 1. Metal abundances derived from two component cloud models.

z	2.168	1.8451	1.1574	0.8643	0.722	0.5524
[O/H]	−2.15	−1.7	−1.2	−0.4	−0.75	−0.55
[C/H]	−2.15	−1.6	−1.3	−1.2	−0.95	−0.55
[N/H]	−2.05	−1.8	−1.5	−0.9	−0.65	−0.2
[S/H]	−1.7	−1.5	−0.9	−0.25	−0.5	
[Si/H]				−0.7	−0.85	−0.25
[Ne/H]	−1.3(−1.0)	−1.2(−0.9)	−0.9(−0.6)			
[Mg/H]			−0.6	−0.55	−0.4	

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References

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